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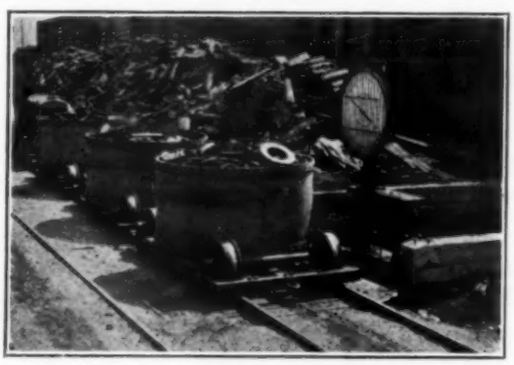
Castings Weigh Materials for Every Man

ALL civilized nations have used some system for determining the weight, or in other words of comparing the mass of various bodies. The balance, one of the oldest instruments employed for that purpose, was used by the ancient Egyptians and other nations of antiquity, while the steelyard was an important factor in commercial transactions of the Romans. The term balance first indicated a beam instrument for weighing materials on two



Scales Are Used Extensively in the Foundry Industry for Weighing the Materials To Be Charged Into the Melting Unit, and for Castings Ready for Shipment

scale pans, but the term has been extended to include other types of apparatus for measuring and comparing weights and forces. Various mechanical devices for weighing are in use today, including the equal arm balance, the unequal arm balance, the spring balance and numerous types of automatic machines. Equal arm balances are the most accurate instruments made and are used extensively in exacting scientific work. Perhaps the automatic scale is the best known type of weighing machine in use today. One of the best examples of that type of scale is found in the automatic computing and weighing machine found at the corner grocery and other types of retail stores. The foundry industry supplies a sizable tonnage yearly, of both ferrous and nonferrous castings for in the neighborhood of $20,000,000 worth of scales and balances.

Find Where Castings Can Be Sold.

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Specializes in

BRONZE BEARINGS

Approximately 75 Per Cent of the 100 Tons of Metal Melted Daily Is Poured Into Bearings for Cars and Locomotives on Various Railroads

By Pat Dwyer

TO A greater or less extent, directly or indirectly every inhabitant of St. Louis at that time in the far western state of Missouri, was interested in and affected by the opening of the Eads bridge across the Mississippi in 1874. For the first time the rapidly growing city enjoyed direct rail communication with the industrial East including the large and important cities along the Atlantic coast. The Father of Waters might rise periodically, pour over the levee and extend miles in width to the far away bluffs in Illinois, but for a certainty the trains would come through on time over a bridge with the masonery piers resting on the everlasting rock 140 feet below the ordinary level of the river.

Day and night for the past 54 years, the tawny, silt-laden flood has been pouring through the arches, rubbing, pushing, seeking a crack or a crevice in which to start the work of destruction. At low water stages the river flows deep and silent in the arc of a circle that bounds St. Louis on the east and also serves as a boundary between the states of Missouri and Illinois. In periods of flood, this greatest of all American rivers draining with its tributaries all that part of continental United States between the Alleghenies and the Rocky mountains rises out of its channel, snatches everything movable, animate and inanimate and bears them away toward its ultimate destination in the Gulf of Mexico.

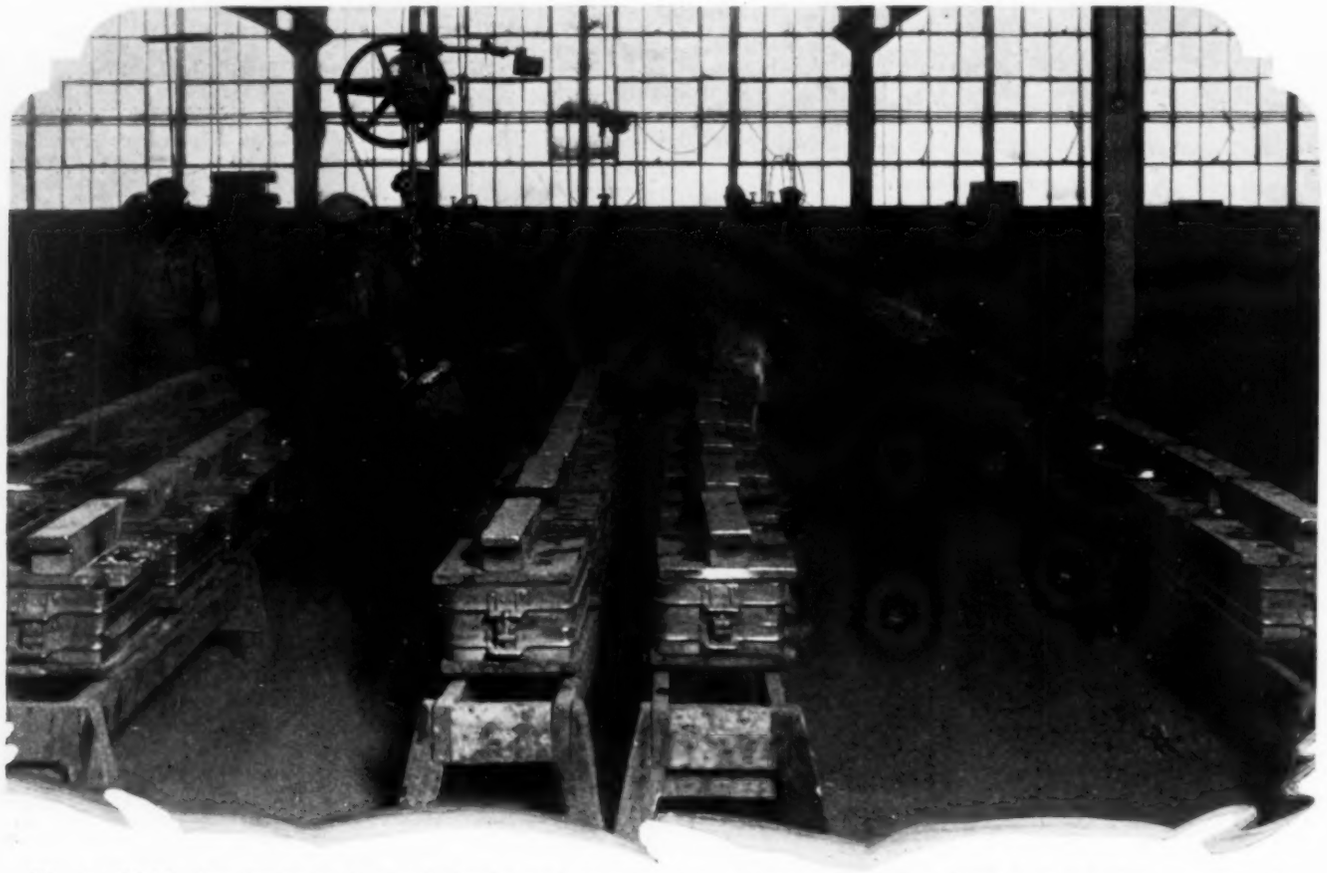


Fig. 1—Molds Are Enclosed in Steel Flasks and Are Set Up on Long Wood Trestles for Convenience in Pouring

Fig. 2—Batteries of Pit Furnaces at the Side and Large Tilting Furnaces Through the Center Are Housed in a Brick Paved, Well Lighted and Well Ventilated Bay

The bridge alone remains unchanged and unchanging, calm, aloof, undisturbed, disdainful above the yellow flood, apparently capable of supporting a steadily increasing load of traffic for an indefinite period. Engineering tests conducted a few years ago indicate that the weight of the compound locomotives and heavy cars rolling across it every hour of the day and night, affect its stability no more than the weight of the little dinky engine and half dozen wooden cars that rolled across it for the first time 54 years ago.

Among the many inhabitants of the city in 1874, none were more interested in the completion of the Eads bridge than two young men at that time contemplating the establishment of a brass foundry. They had little money, but they had faith and hope in the future of St. Louis as a railroad center for the South and Southwest. They had confidence in their ability to produce satisfactory brass and bronze castings. Inauguration of railroad traffic on a bridge over the Mississippi with its attendant increase in the volume of rolling stock requiring upkeep, repair, and replacement in St. Louis, was the final factor in crystallizing their decision to establish a brass and metal business.

Edward Anson More, born in Philadelphia, Nov. 7, 1848, and Henry Thorton Jones, born in Leeds, England, July 31, 1843, joined hands and fortunes in St. Louis in 1874 and established a modest nonferrous foundry on a street not far from the river which it parallels in its curving course throughout the length of the city, that was and still is known as Broadway.

Commencing as a partnership the business was incorporated in 1899 as the More-Jones Brass & Metal Co. with Mr. More and Mr. Jones president and vice president respectively. Mr. Jones died in 1910 and Mr. More who had been chairman of the board for several years died in 1921. Recently the company became merged in the National Bearing Metals Corp., made up of six companies with a capitalization of $8,300,000 and including Damascus Bronze Co., and Keystone Bronze Co., Pittsburgh; More-Jones Brass & Metal Co., St. Louis; Bronze Metal Co., New York; Southern Brass Works, Portsmouth, Va.; and the Brady Brass Co., Jersey City, N. J. John B. Strauch, president of the More-Jones Brass & Metal Co., St. Louis was elected president of the new corporation, with Alexander Turner, New York, chairman of the board.

For many years the old plant on Broadway was taxed beyond its capacity. Following the celebration of a golden jubilee in 1924, plans were prepared for a much larger group of new shops conforming to the latest ideas in construction and methods of operation. An extensive site was secured near the intersection of Manchester avenue, and Kingshighway a short distance south of the east entrance to Forest Park where the Louisiana Purchase exposition was held in 1904.

In this connection it is interesting to note that

through its many changes from a rough bridle path to its present proportions as a magnificent boulevard cutting across the city as a cord to the bow of the river, the Kingshighway still retains the name given to it in early days when practically all the territory west of the Mississippi was held in the name of the king of Spain. It is the only link connecting the present with the remote past, even though the name has been Anglesized from the original *El Camino Real.*

Proximity to Mill Creek valley through which nearly all railroads flow westward out of St. Louis was recognized as one of the important factors in deciding on a location for the plant. Fronting on Manchester avenue, the plant extends south into the valley where a spur track offers ready communication with the main lines of the Missouri Pacific railroad. Loading and unloading platforms with a capacity of 10 cars inside the plant are served by two branches of the spur. With a present melting capacity of between 100 and 150 tons per day, it is apparent that a considerable volume of material constantly is entering and leaving the freight cars.

With a total floor area of 157,000 square feet, the new plant includes a machine shop, a pattern shop and pattern storage, a white metal department, a lining shop, a two-story storeroom, a laboratory and a reclamation department, in addition to the foundry. A semibasement under the pattern storage building has been fitted up for a wash and locker room for the employes. One section is operated as a cafeteria where noon lunches are served at a nominal sum.

Although the color line is not an issue on the floor of the foundry where white and colored men work in perfect harmony, it still is maintained in social intercourse in the locker and dining rooms where separate departments are provided, one for the white men and one for the colored employes.

The plant as a whole, designed specifically for the production of an immense daily output of castings for steam and electric railroads, presents many interesting features in every department, but the scope of the present article is confined to the foundry where the metal is melted and poured into the molds. A considerable volume of miscellaneous castings is handled in addition to the railroad work.

In winter the building is heated by steam lines attached to the walls between the lower edge of the window sash and the floor. The heating system was installed by Skinner Mfg. Co., St. Louis. The brick wall of the building is only 4 feet high. The remainder of the space up to the edge of the roof is occupied by a continuous window along both sides and the greater part of one end. Center sections of the window sash are movable and may be adjusted to promote circulation of fresh air from the outside. Windows in the saw-tooth roof over the molding floor may be adjusted in a similar manner by control chains manipulated from the floor.

A sketch of the floor layout is reproduced in Fig. 3. It is not drawn to scale, but it serves to show the approximate position of the furnaces, cleaning department, coreroom and molding floors. Three rows of steel columns, spaced on 16-foot centers, support the roof. Also on the majority of floors they support crane runways for the accommodation of men handling the heavy crucibles employed in pouring the molds.

Crucibles are employed exclusively for handling all the molten metal. In the pit furnaces they also are utilized in melting the various charges. Equipment for melting and transporting the metal is exceptionally efficient and is housed in one section of the main foundry building as shown in Figs. 2 and 4. The roof over this section of the building is 20 feet higher than the roof over the remainder of the building. It is formed principally of glass and this feature combined with the extensive windows in the side walls insures practically daylight conditions on the floor. The V-shaped roof with movable sash in the upright side walls creates a constant current of air which effectually removes all the fumes incident to the operation of the battery of melting furnaces.

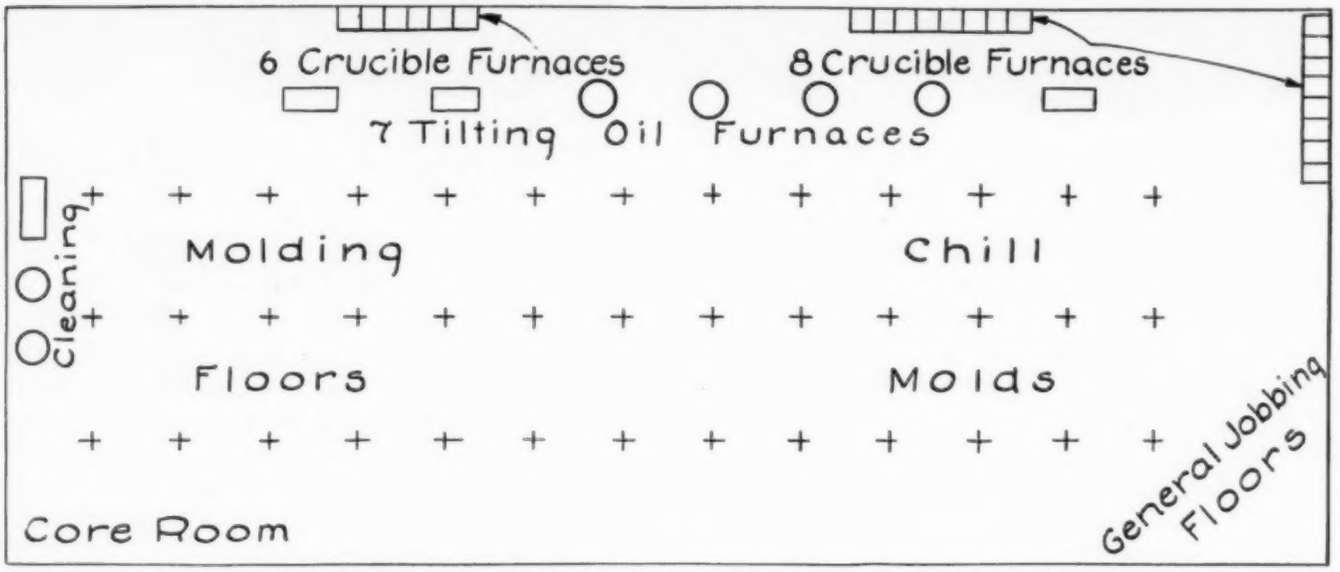


Fig. 3—General Layout of Foundry Floor Showing Relative Position of Various Units

Only a row of steel columns separates the furnace department from the molding and pouring floors. The furnaces are disposed in such a manner that the distance to which molten metal must be conveyed is reduced to a minimum. Also, the various classes of castings are made on certain floors so that the metal may be melted in the nearest furnace. A 1-ton traveling crane made by the Curtis Mfg. Co., St. Louis, serves the furnace department, where it is employed principally in charging the large furnaces with a scoop in which the materials for the charge are assembled.

Jib cranes attached to the columns in front of the furnaces swing the crucibles from under the furnace spouts and place them within reach of the hoists in the various molding

bays. Most of the metal is poured from No. 275 crucibles and since the American system of numbering gives approximately 3 pounds to each number, it is apparent that each crucible holds about 700 pounds.

Wherever possible, mechanical equipment has been adopted to carry the load and do a great deal of the work formerly considered a necessary and inevitable part of the workman's burden. Economy quite as much as altruism is responsible for the innovation. By relieving the workmen of mechanical drudgery, their productivity has been increased along lines in which they specialize and which, up to the present, machinery has not invaded.

Molds are made on power driven machines and the metal is poured from large crucibles suspended from a crane. The molds are arranged in long rows on elevated stands for the convenience of the crucible operators. The rows are comparatively short and are filled several times each day. After a row has been poured the molds are shaken out immediately and the sand is cut over. Four rows of stands are provided on each floor so that pouring at some point is going on continually.

Metal is melted in a battery of seven oil fired open flame furnaces, four made by the Hawley Furnace Co., Easton, Pa., and the remaining three made by the United States Smelting Co., Belleville, Ill. All these furnaces are of the tilting type so that the charge may be transferred readily to the crucibles in which it is taken to the molding floors. In addition to the regular backward and forward tilting mechanism, the United States Smelting Co., furnaces are equipped with an auxiliary tilting gear by which the furnaces may be rotated on an imaginary horizontal axis during the melting period. The furnace is tilted backward and forward by a worm gear and hand wheel. The rotating device is motor driven.

Melting capacities of the furnaces vary. Thus two are rated at 3000 pounds, two at 5000 pounds, one at 2500 and two at 1500 pounds per charge. Under ordinary conditions these figures are adhered to closely, but in emergencies they have been exceeded to an astonishing extent. Oil fuel for the furnaces is stored in large underground tanks and is pumped into a main supply line under pressure. Branch pipes from the main line laid under the floor conduct the oil as it is required to the individual furnaces. A pressure gage and volume meter on each furnace guide the furnace tender in regulating the amount which is admitted at the beginning, the middle and the close of the melting period for each batch of metal. Electrical current is supplied locally and is controlled by a switchboard erected in the company's power house which also contains the air compressors, one of 520 cubic feet per minute capacity, belt driven and made by the Sullivan Machinery Co., Chicago and a second with a rated capacity of 385 cubic feet per minute, direct motor driven and made by the National Brake & Electric Co., Milwaukee, one of the various affiliated companies of the Westinghouse Air Brake Co., Wilmerding, Pa. Thus the source of all power, electrical and pneumatic, is centralized in one room under the direction of a competent en-

Fig. 4—Coke for Each Battery of Pit Furnaces Is Delivered on an Apron Plate from a Long Hopper on the Outside of the Wall. Metal Is Melted in 750-Pound Crucibles Manipulated by an Electric Hoist Suspended from a Monorail

gineer in charge of its maintenance.

Three batteries of coke fired crucible pit furnaces supplement the large oil fired furnaces and provide a flexible melting link for the accommodation of short orders and special mixtures in large or small quantities. Two batteries, one with 6 and one with 8 furnaces, are located close to the east wall, while the third battery, also with eight furnaces occupies a space in front of the south wall, close to the east corner as may be noted in Fig. 3. The six-hole pit in which the No. 70 pots are used is served by a small air hoist suspended from a rail. Each of the two, 8-furnace batteries in which each pot of metal weighs approximately 700 pounds is served by a 1-ton electric hoist made by the Sprague Co., recently taken over by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The crane is suspended from a rail and controlled from the floor.

Have Sliding Covers

Many interesting features in connection with the construction and operations of these pit furnaces are shown in Fig. 4. The top of the furnace wall is flush with the foundry floor which in this vicinity is covered with steel plate rolled with a diagonal pattern on the face to afford good footing. That part of the plate immediately above the pit which extends in front of the battery of furnaces is perforated to form a grating. The section in front of each furnace is movable for the convenience of the fire and ash tender.

The cover for each furnace is made of a light steel channel frame filled with a refractory compound. It is mounted on two steel strips on which it slides either forward to cover the furnace, or backward out of the way while the melter is removing the pot or adjusting the fuel or charges.

Coke bins on the outside of the wall, terminate in a long steel apron projecting a short distance on the inside slightly above the level of the furnace covers. The coke slides by gravity through a long, narrow opening in the wall and is directed into the furnaces as required with a minimum amount of effort.

Style of crucible tongs adopted for lifting heavy pots is shown in Fig. 4. The lower part has been forged carefully to fit the contour of the pot and to grip it closely and simultaneously at the top, the center and near the bottom. In this manner the strain incident to lifting a large quantity of molten metal in a more or less fragile vessel is distributed. Also with a grip of this character the pot cannot tip over.

Since the tongs are built on the same plan as a pair of scissors it is apparent that the pull of the crane hook on the links at the top of the tongs will force the jaws to grip the crucible tightly. However, they do not grip it tightly enough for safety. Therefore a lever has been adjusted to serve as a latch or lock to hold the two members of the tongs rigidly in position while handling the pot. Two men attend the battery of 8 furnaces. Their duties embrace every feature from filling the pots and attending the fires to depositing the crucibles loaded with molten metal on the floor for the pouring gangs to distribute. The usual routine includes four heats per day.

Charges are made up in a storeroom adjoining the foundry on the east. Scrap from various reliable sources, mostly railroads, also new metal are kept in a series of bins labeled *A, B, C,* etc., for identification. Analysis of this material is on file at all times and the mixtures are made up to meet definite specifications. By far the greatest volume of metal is poured into car and locomotive journal bearings. Through the efforts of the American Railroad association and the American Society for Testing Materials the wide range of specifications at one time in use practically has become standardized.

This is the first of two articles dealing with some of the interesting features in a plant recently erected and placed in operation by the More-Jones Brass & Metal Co., St. Louis. A second article dealing principally with molding methods and equipment will be published in an early number.

Cast Iron Will Rust If Not Protected

Question: We are in receipt of an inquiry for rustless iron castings and since we know nothing of the subject we shall appreciate any information.

Answer: If the customer referred to in your recent inquiry is thinking of cast iron to compare for example with stainless steel, he is gong to be disappointed. Cast iron as the term usually is understood rusts to a more or less extent when exposed to the influence of the weather.

However, if he has in mind a special alloy cast iron containing a high percentage of chromium and is willing to pay a higher price, the answer is different. This metal has been developed for use in annealing boxes, for containers in heat treating processes and other purposes where the metal is exposed for prolonged periods to high temperatures. It resists the action of heat, which simply is rusting on an accelerated scale. Undoubtedly it would remain rustless for an indefinite period if merely exposed to the slow action of the atmosphere. If your customer is thinking of castings treated after they are made to render them rust proof the following may be of interest.

Corrosion resistance is sought for a great many special hardware and machinery castings through some form of protective coating. Protection is afforded commonly through one of three basic methods each involving a covering for the surface of the casting which is not readily acted upon by the atmosphere. Coating elements which are used commonly are oxides of iron; thin surfaces of zinc, nickel, copper or other metals; various paints. All the methods for applying protective coatings are fairly familiar. The Bower-Barff process involving the application of plain steam, or steam with which some hydrocarbon compound has been mixed is perhaps the oldest of the oxidizing processes and has had its development in the Swan, Bontempi, Gesner and Weiglin methods. The modern Parker process depending on the formation of a phosphoric coating on the iron is perhaps one of the best known modern applications of chemical treatment for rendering ferrous products rust resisting.

Metal coating probably is most widely known through the electrolytic deposition of nickel, called nickel plating; or the application of molten zinc by galvanizing. Sherardizing is the name of another process for coating ferrous materials with zinc. Copper and alloys of copper are electrolytically affixed upon small iron parts, such as nails, building hardware and other ferrous products.

Painting is the most widely practiced method used for making iron objects rust resistant. The ease with which paint is applied together with the simplicity of the apparatus required has made painting popular. Nickel plating has been practiced for several generations in the stove making industry both for ornamental and protective purposes.

In welding high chromium castings it is preferable to preheat to a good red heat to avoid cracking, says W. B. Miller in a paper before the A. S. T. M. Cooling should be relatively slow, after which the castings may require further heat treatment to produce the necessary hardness. Welding rods of the same composition as the base metal should be used. An excess acetylene flame aids in welding and is allowable for castings which already have a high carbon content.

Testing Society Meets

American Society for Testing Materials at Thirty First Annual Meeting Considers Many Properties of Cast Metals—Investigates Wear Resistance

EXCEPTIONAL in point of attendance as well as in volume of work accomplished, the thirty-first annual meeting of the American Society for Testing Materials was held in Atlantic City June 25-29. This great technical organization numbering as it does representatives from the metalworking, cement, paint, refractories and other branches of industry, performs a two-fold service for industry. The public perhaps is most familiar with its activities through the publication of standards and specifications for engineering materials. Back of these specifications is a tremendous amount of painstaking scientific research in which the best minds of America are brought to bear upon each of the subjects studied.

From a foundry standpoint the 1928 meeting was remarkable for the attention given to cast materials. Specifications for cast iron and the effect of various elements upon the strength of gray iron engaged the major portion of one session. The effect of wear upon steel castings, bronze bushings and other materials, introduced an entirely new field of development. In the nonferrous field new specifications and proposed tentative standards for nonferrous alloys and castings contributed much to the knowledge of these materials. An unusual series of papers presented as an appendix to the report of the committee on nonferrous metals gives data on die castings.

Cast Iron Given Intensive Study

VISUALIZING the American Society for Testing Materials as a great working technical body of which every member is an active power, H. F. Moore, University of Illinois, Urbana, Ill., president for 1927-28 opened the thirty-first annual meeting with a brief address at Atlantic City, Tuesday morning, June 26. He stated the ambition of the executive officers is that every member of the society should be a committee worker, since a larger portion of the accomplishments of the society is through such committee work. He spoke of the balance between research and standardization, the main purposes of the organization and how well the interests of these branches are maintained. In his opinion the American Society for Testing Material can continue to work for the next fifty years and always find ready to hand, work well worth doing.

C. L. Warwick, Philadelphia, secretary-treasurer, in reporting on the papers and publications of the society, told of the increased activity which permitted this convention to offer for consideration 47 papers as contrasted with 32 last year with an increase also in the volume of committee reports representing definite accomplishments of the society.

The report of the committee on the correlation of research of which Prof. H. F. Moore is chairman, briefly sketched the various research projects which are being conducted under the direction of, or jointly under the auspices of the American Society for Testing Materials. These total the surprising number of 78 individual lines of research investigation. One of the most recent general investigations undertaken is the study of wear testing of metals, a problem which the report of this committee listed as second only in importance to the corrosion studies which have been going on for a number of years. The symposium of papers presented at the meeting Tuesday evening inaugurated the work of the society along wear test lines.

New officers of the society, nominated during the spring were declared by the tellers appointed to count the letter ballot, to be elected. These officers are as follows: President, G. W. Thompson, National Lead Co., Brooklyn, N. Y.; vice president, K. G. Mackenzie, Texas Co., New York; members of the executive committee, T. R. Lawson, Rensselaer Polytechnic institute, Troy, N. Y.; H. S. Mattimore, Pennsylvania State Highway Department, Harrisburg, Pa.; P. D. Merica, International Nickel Co., New York; Samuel Tobias Wagner, Reading Co., Philadelphia. These officers were formally introduced to the society.

With President Moore presiding, the second session of the American

Award Medal

RECOGNITION of a distinguished service to the society and to the engineering world was carried in the award of the Charles B. Dudley medal to A. V. deForest, research engineer, American Chain Co., Bridgeport, Conn., on Wednesday afternoon. This award was based upon the work of Mr. deForest presented to the society through his paper, "A Method of Graphic Representation of Magnetic Characteristics," presented at the annual meeting in 1927. Mr. deForest, who was graduated from the Massachusetts Institute of Technology, Boston, in 1912, taught civil engineering at Princeton university for two years and took up his work with the American Chain Co. in 1918.

The third Edgar Marburg lecture was delivered by Dr. Frank B. Jewett, president and director of the Bell Telephone laboratories and a vice president of the American Telephone and Telegraph Co. His subject was "Some Research Problems Involved in Transoceanic Telephony."

Society for Testing Materials, devoted to wrought and cast iron, was called to order immediately following the formal opening meeting.

A study of centrifugal pipe in comparison with sand-cast pipe, made by F. N. Menefee and A. E. White, both of the University of Michigan, Ann Arbor, Mich., at the instance of the city of Detroit, was read by the first mentioned author. The conclusions of the paper held that with present practice and on a similar basis of cost no outstanding advantages were found for either class; but if the annealing practice followed in the manufacture of centrifugal pipe were modified according to methods they offered the investigators would favor centrifugal pipe. F. E. Richart, University of Illinois, joint author with Prof. A. N. Talbot of a paper presented last year on methods of testing pipe raised the question as whether a tension test of a small specimen, such as Mr. Menefee had described, would give a true measure of the strength of the pipe under service, since in the latter case, failure would be experienced at the weakest point. Dr. Richard Moldenke, Watchung, N. J., sounded a warning against the high phosphorus content of some French pipe which he had examined and which showed brittleness. J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., emphasized the remarks on the danger of high phosphorus.

Following this paper T. H. Wiggin, New York, chairman of the sectional committee on cast-iron pipe, working under the American Society for Testing Materials, the American Waterworks association and the American Gas association, stated that investigations now are proceeding to determine properties and specifications of pipe. The first problem is to get a better basis for design of pipe, one which will take into account the inert or trench pressure in addition to the hydrostatic and normal corrosion effects. The next is to define tests of pipe rather than tests of test bars. Finally, he stated that the industry needs to know exactly what constitutes the best resistance to corrosion, and whether the present cement lining or bituminous coatings are inadequate.

R. S. MacPherran, Allis Chalmers Co., Milwaukee, chairman of committee A-3 on cast iron reported on a number of fundamental changes which were recommended and adopted. The specifications governing gray iron castings, cast-iron soil pipe and fittings and high-test cast iron all will be affected by contemplated revisions consisting of changes in the arbitration test bar and the tension test specimen. Members of the committee decided that the arbitration test bar for transverse testing does not give results which are representative of the varying sections encountered in iron castings. They recommended three distinct sizes, representing light, medium and heavy sections as being most desirable, since the present arbitration bar represents only the quality of metal in the ladle. A tentative specification was proposed for an arbitration test bar and tension test specimen for cast iron. This provides a pattern which will give a diameter of 1.20 inches at the center of the test bar.

In announcing the retirement of Mr. MacPherran as chairman of this committee, E. J. Lowry, Detroit, introduced resolutions of appreciation which were adopted by unanimous vote of the members. The new officers of the committee on cast iron, elected Monday night, are as follows: Hyman Bornstein, Deere & Co., Moline, Ill., chairman; E. J. Lowry, vice chairman; Francis B. Coyle, International Nickel Co., New York, secretary.

J. B. Kommers, University of Wisconsin, Madison, Wis., in a paper on the static and fatigue properties of some cast irons, reviewed a series of tests on ten sets of 31 bars cast in the form of the American Society for Testing Materials arbitration bar. These were subjected to tension, compression, impact, transverse, hardness and fatigue conditions. The fatigue endurance limit is shown to be related to tensile strength, hardness and modulus of rupture, but no relation to chemical composition is established. The complex nature of cast iron and the wide range of properties attainable were emphasized both in the paper and by discussion offered by H. W. Gillett, bureau of standards, Washington, and R. S. MacPherran. The effects of melting and pouring temperatures, alloy additions and cooling rates were suggested as further lines of investigation to be carried out and to determine their effects on the properties of cast iron.

F. B. Riggan, Stockham Pipe & Fittings Co., Birmingham, Ala., presented a paper which he prepared in collaboration with Edwin K. Smith on the effect of sulphur on gray iron. This showed that the hardness and combined carbon increase with the rise in sulphur, that fluidity is unaffected, that shrinkage increases up to 0.2 per cent sulphur and then remains constant and that castings carrying sulphur up to 0.2 per cent are not machineable. Other elements in the tests were retained as nearly constant as possible under the tests and the manganese was given as 0.34 per cent. With an increase in manganese, the deleterious effects of sulphur decreased. In response to a question by H. W. Gillett, Mr. Riggan stated that his fluidity was measured by casting at constant temperature in a thin wedge mold extremely long, and machineability was indicated by timing a drill test and measuring the penetration.

Specify Nonferrous Metals

WITH W. B. Price, Scovill Mfg. Co., Waterbury, Conn. presiding the closing session of the metals division of the A.S.T.M. was held Thursday night. The report of the committee on nonferrous metals and alloys was particularly comprehensive. This committee represented new tentative specifications for fire-refined copper, other than Lake, for seamless copper tubes, sand castings of the 80-10-10 composition and for silver solders. The specifications for fire-refined copper covers the production of ingot from ore as well as from secondary sources. The specifications for the alloy of copper 80, tin 10 and lead 10 per cent provides desireable, minimum and maximum portions of the three main constituents and limits the maximum of elements as follows: Zinc, 0.25; iron, 0.10; nickel, 0.50; phosphorus, 0.25; sulphur, 0.05, antimony, 0.25 and with no aluminum permitted.

Tentative revisions were offered by this committee for the specifications covering the following materials and products: Free cutting brass rods for screw machines; naval brass rods for structural service; brass ingot metal for sand castings; bronze bearing metal in ingot form; methods of chemical analysis of manganese bronze. The specification for sand castings of the alloy copper, 88; tin, 8 and zinc, 4 per cent is presented for a change from 40,000 to 35,000 pounds per square inch tensile

strength, and the elongation is dropped from 20 to 15 per cent.

A number of important tentative specifications were advanced to standards including those for aluminum bronze castings, sand castings of yellow brass for general purposes, steam or valve bronze sand castings, composition brass or ounce metal, car and tender journal box bearings and bronze castings in the rough for locomotive wearing parts.

A series of important appendices to the report of this committee make it one of the most outstanding contributions to the 1928 convention. These include the "Nature and Uses of Die-Castings," by Sam Tour, Doehler Die Casting Co., Batavia, N. Y.; a list of alloys agreed on for die castings investigation; standard testing procedure and test records and "Notes on European Die-Casting Practice," by E. V. Pannell, British Aluminum Co., Ltd., New York.

William A. Mudge, International Nickel Co., New York, presented a paper on mechanical properties of nickel, nickel-manganese, and nickel copper alloys, giving complete data in relation to varying proportions of the elements contained in the materials which were investigated.

The report of the committee on metallography, which was presented by H. C. Boynton, John A. Roebling Sons Co., Trenton, N. J. carried as an appendix a paper by H. S. George, Union Carbide & Carbon Laboratories, Inc. on the application of conical illumination to microscopical investigation.

Offer Methods to Check Wear

TUESDAY night's session covered in an intensive manner a wide range of discussion on test methods but dwelt with particular emphasis upon the need for a knowledge of how wear resistance of metals should be measured. The latter phase was covered by four papers prepared by H. J. French, bureau of standards, Washington; John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; W. H. Parker, American Chain Co., Bridgeport, Conn. and J. M. Blake, American Manganese Steel Co., Chicago Heights, Ill.

Mr. French presented an abstract of a more complete report, published by the bureau outlining the wearing and mechanical properties of railway bearing bronzes. Specimens were tested under rolling and sliding friction, with and without lubrication, and at atmospheric and elevated temperatures, as well as under tension, single blow impact and pounding. These tests attempted to approximate the conditions encountered by bearing bronzes under actual service conditions. The Amsler wear testing machine, involving the rotation of the edge of a disk of the bronze against the edge of a revolving disk of steel and with electrical means of increasing temperatures gave the results presented on wear resistance. The results were determined by loss of weight and by visual and microscopic examination of the bronze specimens. It was shown that wear tests at atmospheric temperatures will not determine the effects of alloys or variables of other nature encountered in manufacture, when the temperature of the tests is raised.

The investigator stated that the variations in chemical composition produced changes in properties, but that the changes were not as pronounced within certain ranges as those produced by varying the method of casting. Chill-cast bronzes wore faster and had a lower impact breakage value than sand-cast bronzes, but showed better resistance to pounding and higher tensile strength at temperatures ranging from 70 to 600 degrees Fahr. In alloys with a constant ratio of copper to tin, increasing the lead produced improvement in wearing qualities, but the resistance to pounding, notch-toughness and tensile strength decreased. In alloys with a constant copper to lead ratio, increase in tin from 0.7 to 5 per cent decreased the values in the wear tests without lubricant but improved the general wearing properties. Further increase from 5 to 10 per cent in tin improved the tensile and resistance to pounding, but did not affect the wearing properties. With higher tin, a slight decrease was observed in the impact values.

The paper by Mr. Hall covered tests on 12 per cent manganese cast steel where service conditions were reproduced by making the test specimens the jaws of a rock crusher. This method gave the combined pounding and abrasion condition necessary to bring out the greatest resistance of this type of metal. Abrasion with cold working seems to be required in this case since abrasion alone, as in the case of the Amsler machine, rubbing the specimen on emery under constant pressure and ordinary grinding give but little better wear resisting results with 12 per cent manganese steel than with carbon steel. Manganese steel outwore plain carbon steel 10 to 1 on the rock crusher tests.

Wear tests designed to measure the resistance of tire chains were given by W. H. Parker. He described a machine in which a test specimen is held and revolved against the flat side of a revolving alundum wheel. The specimen makes one revolution to three revolutions of the grinding wheel and a constant pressure is maintained by a fixed weight acting through a lever.

A special machine designed by F. A. Fahrenwald, was described by Mr. Blake. This machine is a grinding machine in which the abrasive, pressure, speed, time and moisture or other liquid content are under constant control. With this machine, Mr. Blake stated a certain alloy of the American Manganese Steel Co. showed a figure of 31 and another 10 in comparison with 100 for commercially pure iron and 72 for white chilled iron.

In the discussion which followed this series of papers H. W. Gillett commented upon the dearth of agreed methods of measuring wear resistance in all cases and offered the comment that the methods given in each case seemed to be designed to bring out certain inherent qualities of the various metals tested, like looking in the back of the book for an answer before working the problem.

An interesting discussion of the three general methods of determining particle size was given by Lincoln T. Work, Columbia university, New York. These include sieve tests, elutriation or flotation, and microscopic measurement. These are applicable in varying degrees to measurement of fineness in cement and other powdered material and more recently to pulverized fuel, where the finely divided particles give up their energy in the furnace and the larger parts are carried out through the boiler stack or drop through the grates as unconsumed carbon.

F. S. Mapes, General Electric Co., Schenectady, N. Y. proposed a method of calibrating the Rockwell hardness testing machine for accuracy of load applied. He suggested supporting a

piece of bar steel, level, upon two knife edges, with a dial gage for deflections immediately beneath the loading nose of the hardness tester. The application of the load upon the bar steel gives a deflection in the bar which may be measured in terms of the known deflection for this particular loading. Checking extensometers by a calibration device through a lever actuated by a calibrated micrometer screw was proposed by R. L. Templin, Aluminum Co. of America, New Kensington, Pa. in an able paper which described the apparatus in detail. A new instrument for testing brittleness of materials, in this case brush holder springs for electrical machinery, was described by P. L. Irwin, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Present New Data on Cast Steel

FEW marked changes were suggested in the report of the committee on steel, submitted at the session Wednesday morning by J. B. Young, Reading Co., Reading, Pa. The specifications for electric cast-steel anchor chains are completely revised and as passed for tentative adoption cover all cast steel to be used in the complete chains, including stud links, enlarged links, end links, swivels, shackles and pins. Proof loads are established, running from 60,000 pounds for 1-inch to 888,000 pounds for 4⅛-inch chain cable. New tentative specifications for black and hot-dipped, zinc-coated, steel pipe for ordinary uses and for iron and steel chain such as is used for slings, hoists, railway, construction and marine service were adopted.

Dr. G. K. Burgess, bureau of standards, Washington, presented the report of the joint committee on the effects of phosphorus and sulphur. This committee, which started its work in 1919, is made up of representatives of the American Society for Testing Materials, the bureau of standards, the war and navy departments, American Railway association, Society of Automotive Engineers, National Research council, American Foundrymen's association, Steel Founders' Society of America, Association of American Steel Manufacturers, Society of Naval and Marine Architects and more recently, the Petroleum institute. The work is in progress on the effect of both residual and added sulphur or phosphorus. Reports have been given on rivet steel, tubes, plates and structural steel. Cast steel is under investigation since 1927, using sand cast test blocks, cast in open molds from normal acid open-hearth steel. These specimens are cast six on a gate, the bars measuring 1⅛-inches square by 12 inches. They are cut from the gate by gas torch and sand blasted. Tests are being made in the annealed, normalized and normalized and drawn state, with various percentages of phosphorus.

The investigation of welded steel pipe, used in the oil industry is in its incipient stages. This material is rolled, annealed and quenched.

The report of the committee on heat treatment of iron and steel of which Prof. H. M. Boylston, Case School of Applied Science, Cleveland, is chairman, was read by John Howe Hall, Taylor-Wharton Iron & Steel Co., Highbridge, N. J. This report recommended the following terms: Full annealing as covering iron base alloys heated above the critical temperature range, holding above that range for a proper period and followed by a slow cooling through the

GUSTAVE WHYTE THOMPSON

Gustave W. Thompson, the president-elect of the A. S. T. M., was born in Brooklyn, July 27, 1865, and has lived there ever since except for a short period of his childhood. He received only a common school education. The Armour institute on June 9, 1927, conferred upon him the degree of D. Sc.

Since 1892 Mr. Thompson has been chief chemist of the National Lead Co. In 1916 he became a director of the company and is a director and officer of a number of its subsidiary corporations.

He holds membership in the following scientific societies in addition to the A. S. T. M.: American Association for the Advancement of Science; American Chemical society; Society Chemical Industry; American Institute of Chemical Engineers, of which he was president in 1918; Chemists Club of New York.

He became a member of the American Society for Testing Materials in 1903 and directed his activities principally in committee E, now committee D-I on protective coatings for structural materials, of which he was secretary for a number of years. He was elected vice president of the society in 1926.

PAUL DYER MERICA

Paul D. Merica, new member of the executive committee of the A. S. T. M. is a metallurgical engineer. He was born in Warsaw, Ind., 1889; the son of Charles O. and Alice (White) Merica. Mr. Merica was graduated from DePauw university, received a B. A. degree from the University of Wisconsin in 1908; and degree of Ph. D. University of Berlin, 1914. He became associate physicist and physicist or metallurgist for the bureau of standards, 1914-1918 In 1919 he became physical metallurgist and superintendent of research, International Nickel Co., Bayonne, N. J. Since 1922 he has been director of research, International Nickel Co., New York, doing research work in metallurgy covering a number of subjects.

Mr. Merica is a member of the American Chemical society; the Institute of Metals (England); Washington Academy of Sciences; American Institute of Chemical Engineers; American Electrochemical society; Iron and Steel institute (England); American Society for Steel Treating; American Society for Testing Materials; American Institute of Mining & Metallurgical Engineers; American Physical society; and the American Foundrymen's association.

range; process annealing to mean heat treating at a temperature below or close to the lower limit of the critical range with cooling as desired; patenting to mean heating above the critical range, followed by cooling below that range in molten lead maintained at a temperature of about 700 degrees Fahr. (365 degrees, Cent.)

N. B. Hoffman, Colonial Steel Co., Pittsburgh, in presenting the report of the committee on ferroalloys reported progress on methods of testing and analysis for ferrotungsten, ferrochromium and ferromolybdenum.

An interesting series of papers on magnetic properties and analysis, consisting of a report of the committee on magnetic properties, given by Thomas Spooner, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and by R. L. Sanford, bureau of standards, of the committee on magnetic analysis, was supplemented by a paper by W. B. Kouwenhoven and J. D. Tebo, Johns Hopkins university, Baltimore and another by Haakon Styri, S. K. F. Industries Inc., Philadelphia.

High Temperature Service

Stiffer service conditions constantly are placing new requirements upon manufacturers of engineering materials and particularly upon fabricators of metal products. In recent years, the conditions of increased stress under higher temperatures encountered in the oil industry and in steam engineering practice have induced keen study of the properties of metals under advanced temperatures.

Three papers at the morning session, Thursday, took cognizance of this major topic. The first covering *long-time* or *flow* tests of carbon steel at various temperatures was prepared by J. J. Kanter and L. W. Spring, Crane Co., Chicago, and was presented by the first named collaborator. A series of experiments conducted on cast steel ranging from 0.23 to 0.40 carbon and rolled or forged steel rod, was performed upon a special apparatus designed for the tests. Standard, tension-type, test pieces with a uniform minimum diameter of 0.505 inches were held within a gap wound furnace capable of developing up to 1400 degrees Fahr. Instruments to each of these furnaces, provided with pyrometer connection and control and recording devices, gave constant information upon the temperature range. The test pieces were held in screw grips, with a lever system of loading. A system of optical measurement readible to 0.00005-inch in the 2-inch gage length gave information on the variation in the test specimens.

Tests were conducted at temperatures ranging up to 1200 degrees Fahr. and at various loadings depending upon the tensile properties of the material. They were subjected to the load and advanced temperatures for various periods ranging up to six months continuously or 4226 hours. The authors stated that carbon content in steel counts for less as the temperature rises and so far as inhibiting flow is concerned, small grain size becomes of little or no advantage. The comforting assurance is given that to bring about rupture in a short period of time, the stress would have to be increased to near the short-time yield point. Higher pressures have comparatively less effect than higher stresses, and accordingly they urge heavy enough equipment, the avoidance of thin walls in pipes, valves, fittings and pressure vessels, both by reason of the resistance to long time flow and also to guard against the weakening effect of corrosion.

In the discussion which followed, H. J. French, bureau of standards, Washington, questioned the value of general conclusions to be drawn from a narrow range of steel specimens due to encountering variables other than those which were being studied. R. L. Duff, Standard Oil Co. of New Jersey, Elizabeth, N. J., stated that although the deformation due to flow was small, much equipment would not permit such condition. He recommended short time tests at higher stresses, to find out the effect of sudden increases of pressure at higher temperatures. He also expressed the opinion that instead of a uniform change in shape or flow, a series of movements was responsible for the total changes reported.

Use Selected Specimens

The second paper in the series also covered the testing of materials at elevated temperatures recommending lines of investigation to be followed. This was presented by the author, P. G. McVetty, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. In view of the variations to be expected in commercial materials, he suggested that tests should be made on selected specimens, in which the uniformity in manufacturing method was held as closely as possible to a standard, but in which the weakest specimens at high temperature were studied. Slow heating of the specimen in the testing machine is recommended as desirable. The writer urges hardness and magnetic tests to attain uniformity.

The third paper by N. L. Mochel, Westinghouse Electric & Mfg. Co., had to do with the sticking or seizing of metals at higher temperatures. An apparatus was designed to rotate the flat surfaces of two metals in contact with each other without lubrication under various loadings and temperature conditions. Preliminary tests at 750 degrees, using a number of different metals are reported in the paper.

Another main division of the Thursday morning session was the con-

Business Session

UNIQUE is the term best applied to the annual presidential address of Dr. H. F. Moore, president of the American Society for Testing Materials at its session Wednesday night. Taking as his theme the life, work, influence and service of Robert Hooke, scientific investigator who lived and worked in the seventeenth century and whom he classed as the first mathematical elastician. Dr. Moore commemorated the 250th anniversary of the pronouncement of Hooke's law. This law which states that the strain is directly proportional to the stress in elastic materials, was stated by the speaker to be the fundamental principle upon which every structural shape, casting, forging, arch or beam has been designed.

C. L. Warwick, in presenting the annual report of the executive committee reviewed the accomplishments of the society for the past year. Its membership has been extended, a new classification of company memberships and a new division of student membership have been set up. A new line of work tending to bring about a wider use of specifications as a basis of market quotation has been inaugurated with the formation of a committee of producers, users and representatives of the business press to study the promotion of the use of specifications in buying copper alloys in the ingot form. A new standing committee on fatigue of nonferrous metals and alloys and one on iron-chromium-nickel alloys have been established. A complete and comprehensive index of all standards and tentative standards, which number about 550 is under consideration. Work in promotion of international co-operation on specifications has been undertaken, with the active participation of the American Society for Testing Materials.

sideration of corrosion and corrosion fatigue. The first paper by D. J. McAdam Jr., U. S. Naval Engineering Experiment station, Annapolis, Md., reviewed previous publications on the subject and reported the investigations of carbon and alloy steels under various kinds of water, where the corrosion effect was prior to testing or induced simultaneously with the stressing. The effects of time, number of cycles of stress, and diameter or thickness of specimen were studied.

F. N. Speller, National Tube Co., Pittsburgh, presented a paper prepared jointly with I. B. McCorkle and P. F. Mumma of the same company, covering the effect of corrosion accelerators and inhibitors on fatigue of ferrous metals. It was found that sufficient inhibitor, in this case sodium dichromate, to stop corrosion in the presence of fatigue prevented the reduction of the ordinary air fatigue endurance limit, when the metal is subjected to cyclic stress and ordinary corrosion. External factors which localize corrosion effect determine the point of failure, and this can be neutralized to a certain extent by the use of proper inhibitors. These findings point to the need for a protective coating that will not break down under cyclic stresses.

J. R. Dawson, Union Carbide & Carbon Research Laboratories Inc., Long Island, N. Y., read a paper by W. B. Miller of that organization recounting the procedure followed in making successful welds on high chromium alloys. A neutral flame is recommended, with welding rods of the same composition as the metal in the case of sheet material. In welding castings, care is advised in preheating to red heat, to be followed by relatively slow cooling after the weld is completed. A flame with excess acetylene is recommended for castings that have a high carbon content.

Vibrator Removes Cores from Small Castings

By B. J. Stern

The brass casting shown at the top in the accompanying illustration is made in several sizes and in quantity lots by a manufacturer of auto appliances who operates his own foundry. These castings are cored as shown and the cores are deep and rather intricate. After the casting is poured in the foundry and cooled in the usual manner, it is slow and cumbersome to knock out the well baked cores by hand. For that reason the vibrating machine shown in the illustration was then designed to expedite this operation.

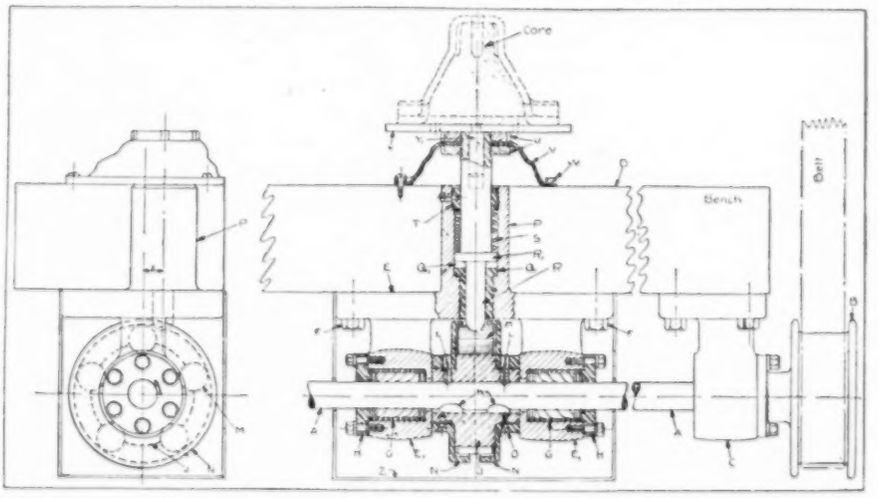
Four units are hung beneath a wood bench, *D*, in the illustration. All of the units are operated by shaft *A*, flexible couplings, not shown in the illustration, being used to connect the shafts at each unit. For the sake of clearness only one of these units is shown, the rest being of the same construction.

The pulley *B*, belted to a line shaft, transmits power through the shaft *A*, which is supported by the end bearing *C* fastened to the end of the bench *D*. The bearing bracket *E*, which contains the unit, is fastened to the under side of the bench by the hexagon head bolts *F*. The projections E_1 of the bracket *E* are bored as shown to contain the roller bearings *G*, upon which the shaft *A* runs. Cover plates *H*, screwed to the outside faces of projections E_1 hold the roller bearings in the nests. The inner faces of the projections E_1 are finished to a fit for the roller plate *J* which is keyed to the shaft *A* by the keys *K* and clamped in place by the set screws *L*. This hardened plate has six equally spaced half round grooves cut in its periphery which contain the hardened rollers *M*. Two cover rings *N* fitting closely about these rollers and fastened to the roller plate by the screws *O*, prevent the rollers from coming out when the plate *J* is revolved, as may be noted in the illustration.

Projecting from the upper part of the bracket *E* is the round stem *P* the center of which is offset from the center of the shaft *A* and the roller plate *J* by the amount *X*. This stem, projecting upward through a hole in the bench *D*, contains a hardened shoulder bushing *Q*, seated in the counter bore Q_1 as shown, in which the hardened plunger *R* is a slip fit. The well rounded point of this plunger rests on the rollers *M* in an off side position, thus avoiding the jamming effect entailed by placing the plunger directly over the roller plate center. A spring *S* tends to keep the plunger ring R_1 against the top of bushing *Q*, the threaded cap *T* fits the top of the counter bore in stem *P* to keep the spring in place. The top end of plunger *R* which projects from the stem *P* is threaded to receive the check nuts *U* which clamp between them the flexible leather cover *V*. The cover is also clamped to the top of bench *D* by steel ring *W*, thus forming a cover which prevents the entrance of any dust or sand into the mechanism of the unit. A hole in the top of plunger *R* contains the stem Y_1 of the removable plate *Y*, upon which rests the casting to be vibrated. Each size of casting takes a different plate thus allowing the fixture to take care of all sizes of castings. A sheet metal cover *Z* encloses the mechanism of the vibrator below the bench as shown in the illustration.

The shaft *A* running at 1000 revolutions per minute imparts 6000 impulses or vibrations to the plunger *R* every minute. Every impulse is followed by a reaction of the spring *S* which snaps back the plunger *R* on its seat on top of the bushing *Q*. In this way a hammering effect is given to the plunger and consequently to the casting being vibrated, through the plate *Y*. This fast vibration and hammering proves efficient in loosening up the core sand which comes cascading out of the casting through holes in the plate *Y*.

W. Scott Thomas, 303 National Exchange Bany building, Providence, R. I. has been appointed New England representative for the Axmann Sand-Throwing Machine Co., 1833 Columbus road, Cleveland.



VIBRATION OF THE PLUNGER REMOVES THE CORE SAND FROM THE CASTING

Cast Iron Is Improving

Use of Heated Molds Is Not New—Employed by the Chinese Many Years—Other Types of High Quality Iron Described

By Edwin Bremer

Part II

USE of heated molds in the production of gray iron castings is not new. Chinese foundrymen have made use of heated molds in producing extremely thin, large-diameter cooking-pots. How long this method has been in use is a matter of conjecture, but probably has been followed for several centuries.

In 1847 Thomas J. Rodman, chief of ordnance, United States army, invented a process for casting hollow cannon, using a core around a tube through which water was circulated. To prevent excessive or irregular strains, a fire was built around the flask to keep it hot and to give a more uniform cooling. A description of this method of casting cannon as used at the Fort Pitt foundry, Pittsburgh, in 1851, as presented in an article by Goostray, Harrington and Hosmer in the May 15, 1925, issue of THE FOUNDRY, follows:

"Again, two 8-inch guns were cast July 30, 1851. The iron was made at the Greenwood furnace, New York, and was 36 per cent of No. 1, 25 per cent of No. 2 and 39 per cent of No. 3. The iron was melted in two furnaces; 12,500 pounds in one and 15,500 pounds in the other, nearly three-fourths being of second fusion, one-quarter third fusion, and the remainder fourth fusion. After melting, the liquid iron remained in the furnace 2½ hours exposed to a high heat. It was then discharged by separate streams into a common reservoir. At the same time it was withdrawn from the reservoir in a single stream. After proceeding a few feet, this separated into two branches leading to separate molds, and filled both molds at the same time. One of the castings was made solid and cooled in the usual manner. The other was cast hollow and cooled by the Rodman process. A fire was kindled in the bottom of the pit directly after casting and was continued 60 hours. The pit was covered and the iron flask containing the mold was kept at as high a temperature as it would safely bear.

Testing of these guns commenced Aug. 28, and continued until Oct. 22. The one cast solid stood 73 fires and the one cast hollow stood 1500 fires. The density of the iron used was 7.287, and the tenacity, 37,811."

Extracts from the reports of experiments on the strength and other properties of metals for cannon, government report 1856, are as follows:

It will be seen that the endurance of the guns cast hollow surpasses those cast solid in every case where both were cast at the same time and from the same material, the difference in one case being 20 to 1, and the aggregate of all, 11 to 1. This great difference occurring in every instance where guns were cast, and tried in pairs could not, it is believed, have been caused by any accidental circumstances, for the method pursued to insure an exact equality of material in both guns of each pair and for preserving an exact uniformity in the proof of each, seem to forbid the supposition that any unknown inequalities could have existed, either in the casting or the proving. The great difference of endurance must therefore be ascribed to the different methods by which the castings were cooled, and to those above.

A convenient method for determining the condition of the iron while in fusion, and whether it has arrived at the proper condition for casting or should be longer in fusion, is found in dipping from the melted pool of iron and casting into small bars 10 inches long, 2 inches square at the top, down to ¾-inch at the bottom in a step form in four sections. They are cast open in green sand and allowed to remain in the sand 10 minutes, then taken out and cooled carefully with water, then broken at the different places and the condition of the iron judged by the several fractures. These fractures will exhibit various aspects from white at the small end to a mottled in the middle, and to a dark gray at the large end; and a practiced eye will soon be able to mark the process of the changing quality of the iron and to determine the proper time for casting the gun.

Iron used for casting cannons was melted in air furnaces as may be gathered from these extracts. It was poured at a high temperature, and although no analysis of the iron is given, the reference to the appearance of sections of varying thickness in the test bar would lead one to assume that this was a low silicon iron since the fracture is white in a ¾-inch square piece. Carbon also probably was low because of the tendency of the air furnace to oxidize the carbon of pig iron during the melting.

As for limiting the total carbon plus the silicon to 4 per cent (C+Si=4 per cent), Frank E. Hall in a paper on semisteel shells presented at the February, 1920, meeting of the American Institute of Mining and Metallurgical Engineers in New York, remarks:

The total of carbon and silicon content below which it is unsafe to go is probably in the neighborhood of 4 per cent. It would not be wise to continue at this point for many heats in succession as, in addition to the liability to sluggish metal, there is danger of its chilling white unless carefully cooled, the more so as the remelt is returned day after day. The best results appear to lie between 4 and 4.40 per cent, with the total carbon as near 3 per cent as possible and the combined carbon at or near 0.60 per cent.

Cast iron or semisteel used in manufacturing shells, according to a table given in the article, contained from 1.04 to 1.40 per cent silicon; 0.095 to 0.123 per cent sulphur; 0.080 to 0.120 per cent phosphorus; 0.55 to 1.10 per cent manganese; 2.81 to 3.22 per cent total carbon; 2.09 to 2.60 per cent graphitic carbon, and 0.47 to 0.72 per cent combined carbon. Tensile strength was from 32,800 pounds per square inch to 49,000 pounds per square inch, and the brinell hardness from 179 to 229.

A. J. Richman in the *Foundry Trade Journal*, Nov. 26 and Dec. 3, 1925, describes the manufacture of diesel engine castings. He used a 30-inch cupola with an air pressure of 8 ounces per square inch and volume of 24 cubic feet per second. The metal charge weighed 700 pounds and the coke consumption was 8 to 1. The mixture charged into the cupola was composed of 20 to 30 per cent steel scrap, No. 3 Scotch iron cylinder scrap, and No. 4 hematite pig iron. No analyses of the scrap and pig are given. The metal was poured into dried molds at an average temperature of 1380 degrees Cent. as determined by an optical pyrometer. No special preheating was practiced, but the molds were poured as soon as possible after being removed from the drying oven. In this manner the mold temperatures may have varied between

80 and 100 degrees Cent. In a liner casting weighing 1200 pounds, with an average thickness of 1½ inches, the mold temperature was about 95 degrees. The liner was made from iron with an analysis of silicon, 0.97 per cent; phosphorus, 0.2 per cent; manganese, 0.6 per cent; and total carbon about 3.2 per cent. Although this casting made in a warm mold was perfectly gray, the runners were hard and varied from a white to mottled fracture.

Cast iron with a pearlitic structure and high strength has been obtained by mixing molten pig iron and molten steel. This modified iron will have a carbon content from 2.6 to 2.8 per cent. This process of mixing liquid steel and liquid pig iron is somewhat similar to that used by the late J. E. Johnson Jr., on the production of a special grade of iron for foundry purposes. Johnson's method was to take a certain quantity of molten pig iron and blow it in the bessemer converter until it was *wild* or contained a great excess of oxygen. The steel was mixed with a definite amount of molten pig iron to obtain an iron with a definite silicon content, and poured into pigs which subsequently were melted in the cupola and made into castings. Excellent results, with good graphite distribution and high strength were claimed for the castings made from this synthetic pig iron.

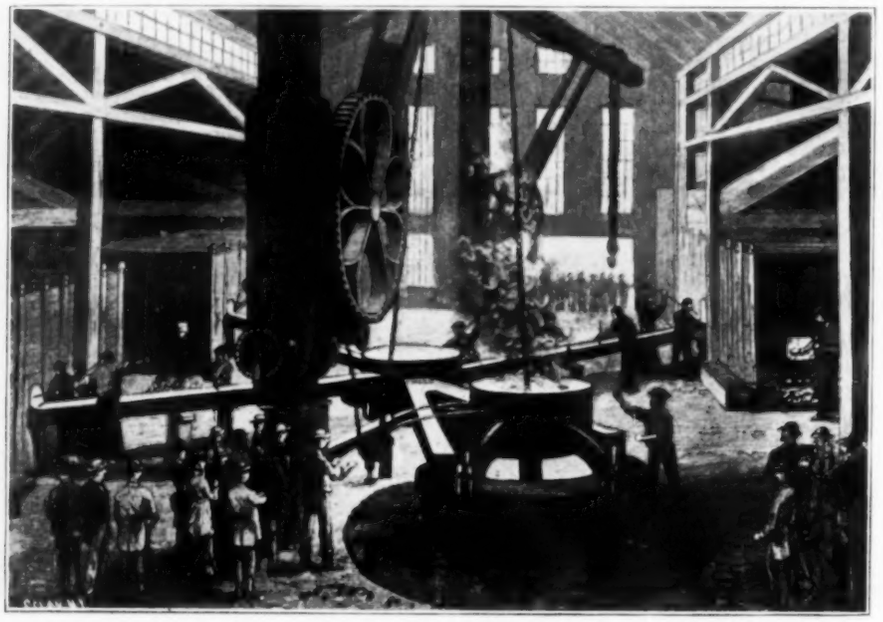


FIG. 9—AN OLD METHOD OF CASTING IRON CANNON AS USED IN THE SOUTH BOSTON IRON WORKS IN 1884

A few years ago a special cast iron was developed by Meehan. It is claimed that most of the graphite in this iron exists in small nodules in a matrix of ferrite and pearlite. Other characteristics claimed for this particular iron are high tensile strength of 45,000 to 70,000 pounds; resistance to high temperatures; tensile values of 45,000 to 59,000 pounds per square inch at 800 degrees Fahr.; transverse strength of 5500 to 7000 pounds per square inch, and high resistance to corrosion and abrasion.

The method of producing this metal is patented, but little information is given on the details. Essentially, the process calls for a molten white cast iron to which a silicide, such as calcium or magnesium silicide, is added. Calcium silicide, which preferably is used, is said to remove the occluded gases and precipitate the carbon. Since a white iron is used, there is no doubt as to a low carbon and silicon content before the addition of the silicide. Calcium silicide is used as a degasifier in molten steel up to 50 ounces per ton in medium and high carbon steels, and the reaction is stated to be between the oxygen in the steel and the silicide forming calcium silicate which rises to the top and joins the slag.

Since little information is given as to the exact method employed to obtain the graphitizing effect of calcium silicide except that it is added to molten white cast-iron, the silicide is presumed to be added in the ladle. Smalley, in some experiments he performed, added varying amounts of calcium silicide to molten white iron in the ladle and found that 1 per cent calcium silicide addition enabled the casting of ¾-inch square bars uniformly gray. Bars less than ¾-inch presented white corners and edges and offered machining difficulties, and bars less than ⅝-inch were white. Using 0.50 per cent calcium silicide and 2.5 per cent ferrosilicon, the casting of ¼-inch square bars of uniformly gray iron was possible. The original iron used by Smalley contained 2.6 per cent total carbon; 0.90 per cent silicon; 0.15 per cent phosphorus; 0.30 per cent manganese, and 0.06 per cent sulphur.

Although not in possession of the details of melting it is understood that considerable quantities of steel are used in the charges placed in the cupola when producing iron for the Meehan process. That this could be done is borne out by Smalley's work where he used a white iron containing as little as 2.6 per cent total carbon. As previously mentioned, the degasifying effects as applied to steel also should give beneficial effects in the cast iron produced by the use of calcium silicide. The degasification would tend to produce a metal of greater density or solidity, and with an increase of solidity, better physical properties may be expected.

Alloy cast irons have been used successfully in making castings for heavy duty purposes. The alloying elements most frequently employed are nickel, chromium, manganese and sometimes molybdenum. Nickel may be added in the pure state either in shot or pig form. The others, owing to the high temperature required to melt them, are added in combination with iron, such as ferrochromium, etc. In recent years a native iron ore containing both nickel and chromium has been mined in Cuba, transported to the United States and smelted in the blast furnace by the Bethlehem Steel Corp., Bethlehem, Pa. The pig iron produced from this ore, according to data supplied, has the following analyses: Silicon, from 0.25 to 2.25 per cent and above; phosphorus, 0.10 per cent maximum; sulphur, 0.05 maximum; manganese, 0.60 to 2.00 per cent; nickel, 0.80 to 1.25 per cent; chromium, 1.60 to 2.25 per cent; titanium, 0.10 to 0.20 per cent; vanadium 0.05 to 0.08 per cent; total carbon depending on silicon, 3.80 to 4.50 per cent.

This nickel-chromium pig iron seldom is used alone as a charge. Generally, it composes 10 to 25 per cent of the charge which may consist of foundry pig iron, bessemer pig, various scrap irons, steel scrap, etc. Properties claimed for castings made from metal containing additions of this pig iron are increased tensile strength, resistance to oxidation at high temperatures, freedom from hard spots and porosity, better transverse and impact tests and less distortion under pressure.

An alloy composed of nickel, 60 per cent; chromium, 12 per cent and the remainder low carbon steel is manufactured by the Driver-Harris Co., Harrison, N. J. This alloy is added to the molten iron in the ladle in quantities from 1.00 to 3.00 per cent. Advantages claimed are an increase in tensile and transverse strengths, and although the brinell tests show increased hardness, the metal machines as easily as the untreated metal.

Nickel has an action similar to silicon on cast iron, namely, it precipitates graphite and decomposes the carbide formation. In 1907 Guillet described the effects of the addition of up to 50 per cent nickel on the constitution of white and gray cast iron and noted that graphite was precipitated and that the matrix was changed from pearlite to sorbite. Herein is the difference in hardening action of silicon and nickel as a reduction of silicon to increase hardness promotes the formation of hard carbides, but nickel acts on the matrix changing it from pearlite to a harder and tougher constituent, sorbite. According to the International Nickel Co., New York, 1 per cent of nickel is equal to ½ per cent of silicon in reducing chill areas, hard carbide spots and mottled sections.

Chromium refines the grain of iron and increases its chilling power even in small amounts from 0.10 to 0.50 per cent. When present in excess it forms chromium carbide which is exceedingly hard. In heavy sections chromium is effective in holding the combined carbon around 0.80 per cent which approaches that of the eutectoid or pearlitic formation. Nickel restrains the chilling effect of chromium and by its use the beneficial effects of chromium may be utilized without its disadvantages. Usually it is desirable to add nickel and chromium in the ratio of 3 to 1 respectively to balance their opposing influence on chill.

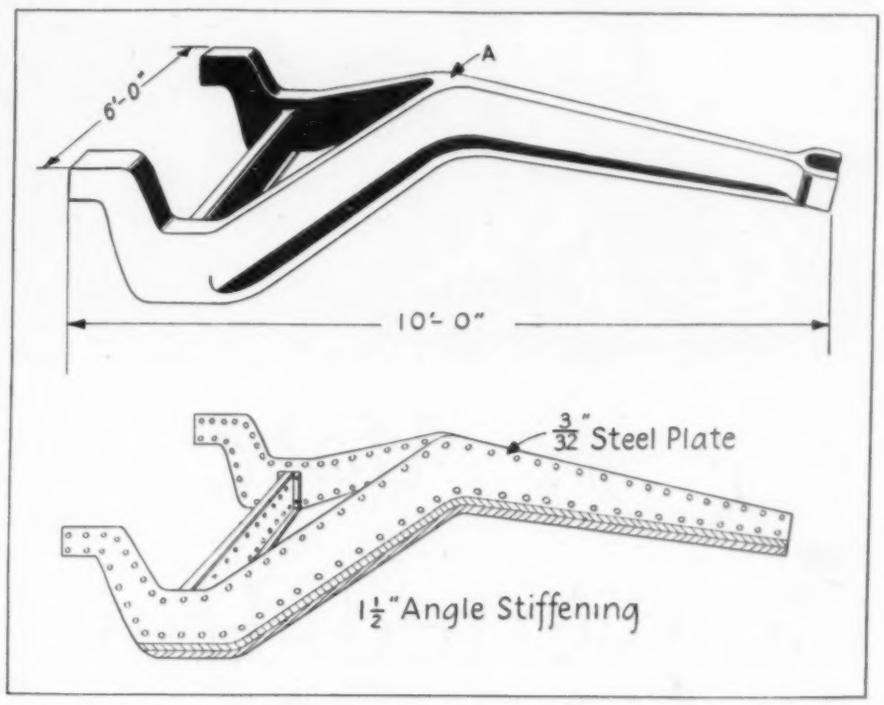
Steel Skeleton Prevents Pattern Distortion

By F. C. Edwards

In order that a finished pattern may successfully withstand the pressure due to ramming it is necessary that the patternmaker should arrange the grain of the wood and the various joints in such a manner so as to obtain the maximum strength from the materials used. The most skillful arrangement of grain and joints, however, occasionally fails to give the necessary strength to enable the pattern to retain its shape. The alternative in such a case is usually a metal pattern. In this event, the master pattern is temporarily strengthened by "stopping-off" pieces, and extreme care is taken while molding to avoid distortion.

There are cases where all-metal pattern would not be expedient on account of excessive weight, or liability to frequent alteration to suit varied work. In such cases a composite construction may be resorted to using metal reinforcement at points where the wood itself is too weak to stand alone. An example of this class of pattern is given in the accompanying illustration which shows a triangular lever for a large platform scale. These castings are useless if they are at all distorted. Since the base is not in one plane, and the three ribs which form a junction at the crotch *A* run in different directions, the problem of making an efficient joint in wood alone is extremely difficult. It is obvious that while the pattern is being embedded in the sand the greatest strain is thrown on the crotch.

In this instance a mild steel skeleton, as shown, was built up of 3/32-inch plates welded at the joints, and stiffened up with 1½-inch angles. Slabs of well-seasoned mahogany were then screwed to each side of the plate. The screws passing through holes which had previously been drilled in the plate. This pulled the two sides tightly together. The pattern was finished in the usual manner and after having been in constant use for several years it is still producing satisfactory castings free from distortion.



THE WELDED STEEL SKELETON SUPPORTED THE WOODEN PATTERN

Institute of Metals Plans Liverpool Meeting

Over 200 members, including many from overseas, have indicated their intention of taking part in the Liverpool meeting of the British Institute of Metals, to be held from Sept. 4-7. Papers to be presented include a valuable series dealing with the die-casting of alloys, as well as the eighth report to the corrosion research committee. A discussion of corrosion problems will form a feature of the meeting. On the social side, the gathering promises to be a pleasant one. A series of receptions, visits to places of interest, and other functions is being arranged by the local reception committee. An election of members was held on July 4 in connection with the Liverpool meeting, full particulars of which may be obtained from Mr. G. Shaw Scott, M. Sc., secretary of the Institute of Metals, 14, Members' Mansions, Westminster, London, S. W. 1.

T. H. Scaffe has been made manager of the Detroit office of the United States Electrical Tool Co., Cincinnati. R. F. Brayer also has been added to the personnel in the Detroit office. Mr. Scaffe has been connected with the Detroit office for a number of years.

Make Steel

in a

Converted Iron Foundry

[Large Company with Plants in Various Cities Transforms Brakeshoe Plant]

By F. B. Pletcher

IN SEPTEMBER, 1927, the American Manganese Steel Co., Chicago, purchased the Burnside plant of the American Brake Shoe & Foundry Co. in the same city. By Jan. 1, this year, plans were completed for conversion of the gray iron foundry into a plant for the production largely of manganese and other alloy steel castings. By April 1 production was well under way.

The new unit is known as Plant D of the American Manganese Steel Co.'s chain of plants throughout the country, and will add 2500 tons yearly to the present annual capacity of about 25,000 tons of the company's aggregate output.

Other plants of the company are located at Chicago Heights, Ill., New Castle, Del., Oakland and Los Angeles, Calif., Denver, and at St. Louis, where the plant still is known as the Southern Manganese Steel Co. Products include manganese steel castings for railroad frogs, crossings and switches, manhole frames and covers, heat resisting and corrosion resisting alloys, machine molded gears, parts for crushers, dredges, pumps, road building machinery, construction, mining, blast furnace, rolling mill, foundry and forge shop equipment, sheaves, wheels and rollers, widely used in hoisting and loading equipment and in the oil industry. The new plant also has facilities for turning out gray iron jobbing castings.

The main foundry bay, 80 x 250 feet from north to south, is flanked by a side bay on the west, 40 x 200 feet, and by another on the east, 40 x 150 feet. The main foundry structure may be extended 100 feet to the south if the space is needed eventually. The core making department parallels the main foundry bay for about three-fourths its length. Machine shop, shipping and inspection departments lie to the south of the coreroom. A newly built lean-to at the east of the core department houses the acetylene generators for the oxyacetylene welding operations. Another lean-to nearby contains equipment for preheating the oil. The pattern shop and storage are located to the north of the main foundry department, and the cleaning department occupies the south section of the east bay, adjacent to the shakeout in the main bay. An outside electric substation stands near the north gate of the foundry yard. The scrap storage adjoins the west furnace bay. The laboratory and research department occupies a part of the office building at the entrance. A monorail system to be built later will connect the main foundry with the core-making department.

New equipment installed includes

an electric furnace, molding machines, sand handling equipment, an annealing furnace, a semiautomatic water circulatory system for the furnace, sprinkling system, fire hydrants, 400-ton straightening press, four stand grinders, eight swing grinders, four stiff-shaft grinders, a sand mixer, boiler room for preheating oil, oil storage tanks, oxyacetylene welding system and generators, and increased machine shop facilities.

Uses Electric Furnace

Steel is melted in a 1½-ton furnace manufactured by the Pittsburgh Electric Furnace Corp., Pittsburgh. The furnace installation at the entrance of the west bay adjoins two 12-ton per hour cupolas previously installed by the Whiting Corp., Harvey, Ill. A concrete lined pit at the tapping side of the furnace facilities the handling of the heavy ladles. A 2-ton jib crane, manufactured by the Harnischfeger Corp., Milwaukee, carries the charge into the furnace. Scrap in the charge used consists of bolts, nuts, low phosphorus punchings and other low phosphorus and low sulphur scrap, including bundles and structural steel scrap. The ferroalloys used are largely 80 per cent ferromanganese and 50 per cent ferrosilicon.

On a full operation schedule to be attained shortly, ten molders will be employed at each of the eight stations. Metal is poured by a separate force. At present one pouring crew of six men takes care of the heats. Ultimate arrangement calls for about ten heats daily, and additional pouring crews will be added as the output attains the rate set.

The car type mold drying oven, part of the original equipment and located in the west bay, was manufactured by the Swartwout Co., Cleveland, and is equipped with special radiation type heating elements. Four trucks loaded with molds may be dried at one time.

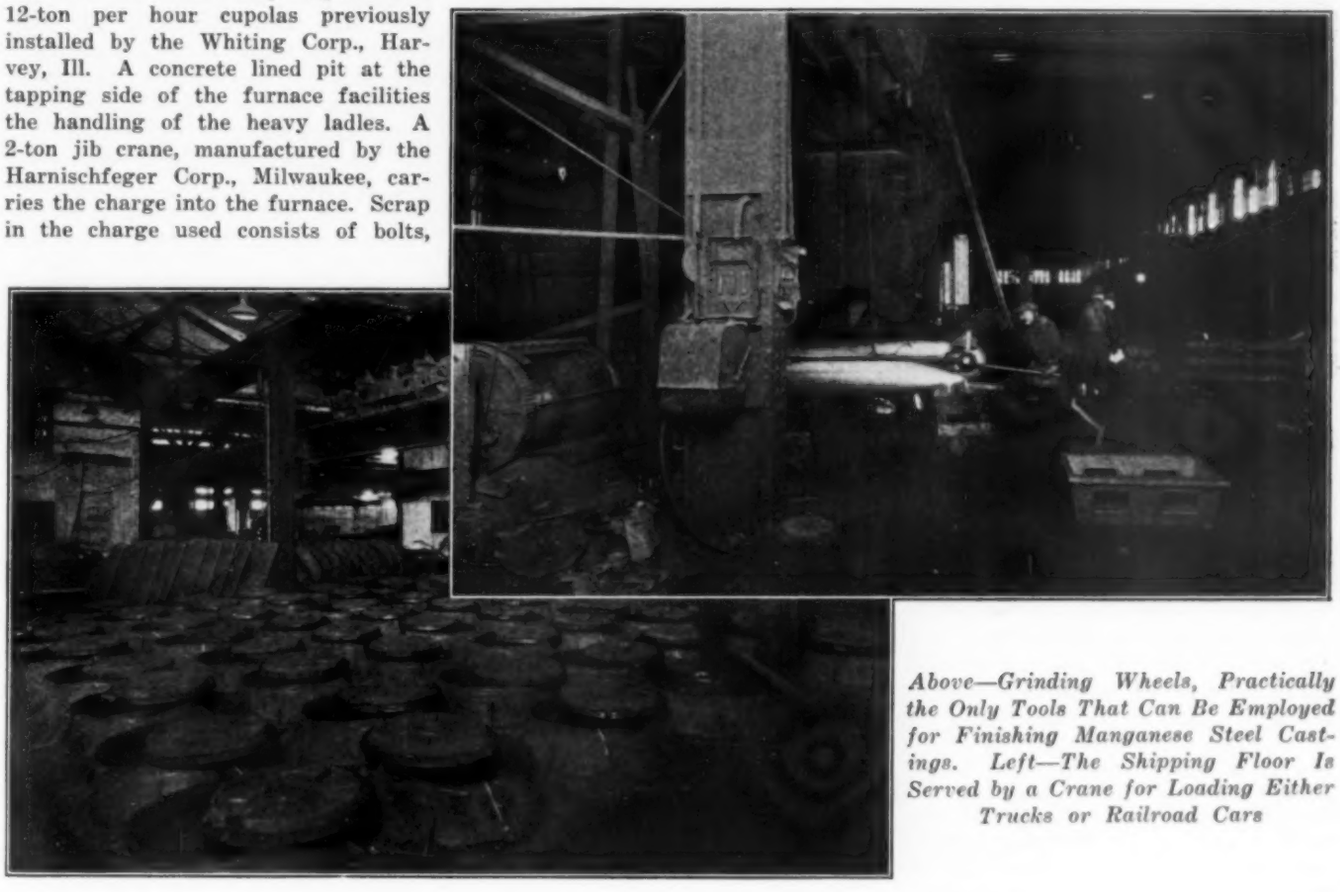
The 20-ton annealing oven, also in the west bay, was furnished by the Carborundum Co., Perth Amboy, N. J. The truck can accommodate 25 cast frogs and switches in each load. It is geared to a double track and is driven by a 20-horsepower alternating current motor with direct line feed furnished by the Allis Chalmers Mfg. Co., Milwaukee.

Sand preparation and handling equipment with the exception of the facing outfit was designed, manufactured and installed throughout by the Link-Belt Co., Chicago. The shakeout hopper, 16 x 20 feet and set at floor level, is covered with bar grating through which the sand drops to an apron conveyor at the head of which is set a short-center, magnetic separator belt for removal of scrap, gaggers and all metallic particles before delivery to the bucket elevator. This scrap and other metallic material is removed in boxes through a trap door by the overhead crane.

Sand is carried by a 12 x 7-inch bucket elevator to a tapered hexagonal revolving screen which acts as a breaker of lumps in addition to thoroughly screening and removing refuse from the sand. This screen is completely housed in a steel box to which is attached a suction line and dust collector for the removal of dust and fines from the sand.

Sand from the screen falls on a belt conveyor at the head end of which a two-way spout is arranged for diverting the sand to either the backing or facing sand mill. Water is added in proper quantity through a spray pipe across the bed of sand passing on this belt conveyor which discharges to a double paddle mixer or pug mill which mixes and reconditions the backing sand. Backing sand is handled by a short cross belt conveyor operating alongside the columns in the main foundry bay. By adjustable plows this sand may be discharged at any point through the length of the shop to shoveling hoppers for floor molding purposes.

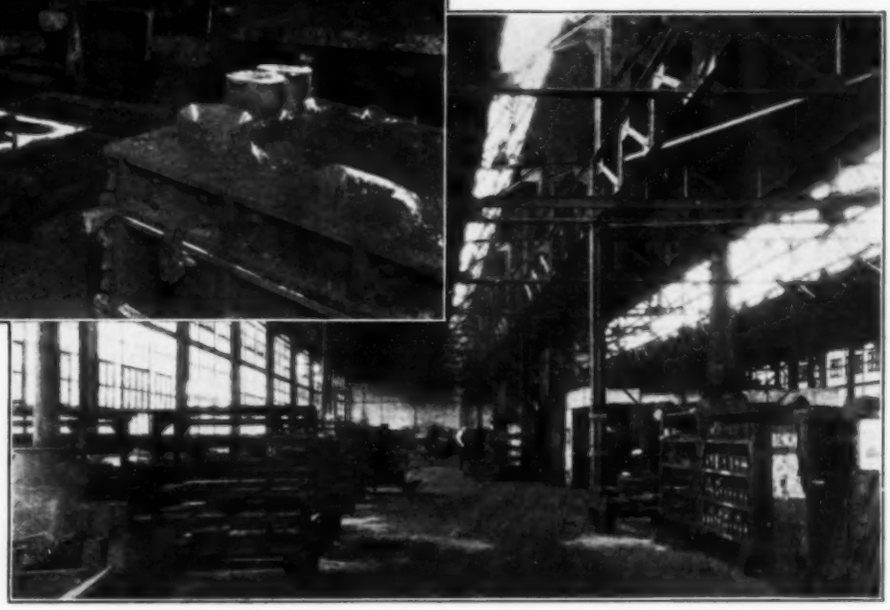
Where old sand is required for facing, the water spray is shut off and the sand is diverted to a double hopper set over a muller type sand mixer made by the National Engineering Co., Chicago. The second compartment receives new sand from the storage by the crane and grab bucket. Facing sand is distributed through the foundry by boxes mounted on electric lift trucks. Fire clay, oil, molasses and cereal binders are em-



Above—Grinding Wheels, Practically the Only Tools That Can Be Employed for Finishing Manganese Steel Castings. Left—The Shipping Floor Is Served by a Crane for Loading Either Trucks or Railroad Cars

ployed in various proportions in the mixtures, according to the design of the core and the place it occupies in the mold.

The sand distributing belt conveyor discharges sand to a large overhead hopper fitted on the bottom with an apron feeder 8 feet wide for filling the long guard rail flasks. Each flask is filled in about 4 seconds. The feed is controlled by electric push button. Molds are carried first to the pouring floor and later by crane to the shakeout station at the south end of the main bay. This bay is equipped with three 15-ton cranes, part of the original equipment. East and west bays each have two 5-ton cranes.



Molds Are Jolted on a Machine Under a Sand Supply Hopper. Right—Small Cores Are Loaded on Racks and Conveyed To and From the Ovens on Trucks

The core-making department has one 5-ton crane. A 10-ton crane, manufactured by the Shaw Crane Works, Muskegon, Mich., has been installed for the sand storage.

Molding practice calls for a dry sand drag and a green sand cope. Twelve concrete sand storage bins are arranged along the east working bay adjacent to the main foundry floor for convenience in floor molding. The sand is accessible and does not have to be carried far.

Cleaning room equipment includes four stand grinders, eight swing grinders and four stiff-shaft grinders for line grinding, manufactured by the Norton Co., Worcester, Mass., and the Sterling Grinder Co., Tiffin, O. The 36-inch wheels on the stand grinders are placed on the 30-inch stand grinders after they wear down. Later they are pressed into service on the 24-inch grinding wheels when reduced to the corresponding size. After fulfilling this service the wheels are transferred to the swing grinders. All grinders are driven by individual alternating current motors made by the Allis-Chalmers Mfg. Co., Milwaukee. Plans are under way for the installation of sandblast equipment in the cleaning department. Other cleaning room equipment includes six tumbling barrels and a 400-ton press designed in part to meet the requirements of the particular type of castings produced in the newly developed plant. The machine is an open throat 2-cylinder hydraulic straightening press 10 x 22 feet 4½ inches, manufactured by the Southwark Foundry & Machine Co., Philadelphia. The press is operated from a vertical triplex pump and has a special air-hydraulic prefill system on both vertical and horizontal rams. The stroke of the vertical ram is 2 feet and that of the horizontal ram 3 feet. Flat castings, even to the size of locomotive frames, can be handled on this press.

Molding machine equipment includes two rollover jolt machines manufactured by the Herman Pneumatic Machine Co., Pittsburgh, eight jolt and rollover machines furnished by the Osborn Mfg. Co., Cleveland, and four rollover jolt machines furnished by the International Molding Machine Co., Chicago. One of the Herman rollover jolt machines is used for guard rail casting. Comparatively little hand molding is done. Air compressors and equipment were furnished by the Ingersoll-Rand Co., New York, and the Chicago Pneumatic Tool Co., Chicago.

Many Ovens Used

The coreroom 150 x 180 feet is well lighted and spacious and is amply equipped for the contemplated production activities. In the north end heavy cores are made. The equipment includes four rollover core-making machines made by the Osborn Mfg. Co., Cleveland, 12 ovens of the rack type, two of the car type, and 24 shelf type ovens. The ovens formed a part of the original equipment before the plant was taken over by the American Manganese Steel Co. All are coke fired. Girls are employed for the light bench work.

The water cooling and circulating system for the furnace is developed so that all water is returned to a hot tank by gravity. The only loss is through evaporation, which is estimated to be not more than 5 per cent. The unit consists of a cooling tower, three centrifugal pumps, hot and cold wells, motors and quenching tank. The cooling tower was furnished by the Standard Power Equipment Co., St. Louis. The quenching tank, 10 x 11 x 19 feet, was made by the American Manganese Steel Co. Both the hot and cold wells are 7 x 16 feet in size with depths of 12 feet each.

The transformer is cooled by oil circulated by a motor driven centrifu-

gal pump manufactured by the Perfection Machinery Co., Minneapolis. Thermostatic control keeps the oil at a temperature of 50 degrees. Two oil storage tanks outside the heating lean-to have a capacity of 11,000 gallons. The oil heating equipment was furnished by Tate-Jones & Co., Inc., Pittsburgh.

Pipe the Oxygen

Two generators for oxyacetylene welding were furnished by the Air Reduction Sales Co., New York. They were designed for the production of acetylene under the required pressure for effective pipeline distribution. Each generator, with a capacity of 300 cubic feet, is equipped with automatic feed of the carbide to water with pressure diaphragm control. They may be used either singly or together. The 20-cylinder oxygen manifold is connected to the oxygen pipe line which is run parallel to the acetylene line. The oxygen pipe lines are supplied with latest safety devices.

Patterns are stored in a three-story pattern vault, served by an elevator. Each customer has his individual rack for pattern storage. A card system is used for the pattern records, and the designations are by shelf, rack and section. Every precaution has been set up to guard against fire in the pattern storage. A complete sprinkler system and other safety methods help make the storage vault what the management regards as practically fireproof as is possible to obtain.

Ladles are dried in an oven manufactured by the Paul Maehler Co., Chicago. Each ladle is dried in about 2 hours. The scrap storage adjoining the furnace bay on the west is arranged compactly so that a 15-ton crane made by the Northern Engineering Works, Detroit, can carry the scrap from any part of the yard to the charging station just inside the door of the furnace bay where the jib crane handles the charge to the electric furnace. The machine shop is served by a 5-ton crane furnished by the Harnischfeger Corp., Milwaukee. The machine shop adjoins the shipping room on the north, and contains equipment in use under the former ownership. Some additional equipment is to be ordered for this department.

The shipping room has ample facilities for storage. The castings ready for shipment are placed on raised platforms from which they may be loaded on trucks, or railroad cars that are backed in on a spur track.

Metal is tested before it is tapped from the furnace. The next inspection is before the castings reach the grinding machines. All that pass then are routed to the grinding wheels. The castings are given a third inspection before heat treating. A fourth inspection takes place after the castings have been heat treated and tumbled to remove scale. Many of the castings also are gaged for accuracy of size and shape. A final inspection in the shipping room practically insures the customer's reception of a perfect casting.

Girls Are Employed on Light Machine and Bench Work in the Coreroom

Separator Removes Iron from Sand

PRESENCE of scrap iron, gaggers, shot and fine particles of iron in molding sand probably will lead to an increased casting loss unless proper steps are taken for the removal of the foreign materials. The problem of removing the ferrous materials from the sand has been solved in many instances by passing the sand over a magnetic pulley separator, which effectively removes even the small pieces of iron. Perhaps it may be said without contradiction that a majority of the large sand handling and preparing units, which have been installed in recent years, where the sand is carried on conveyors from the shakeout to the preparing unit and hence to the storage bins at the molding stations, are equipped with magnetic separators.

Two interesting examples of magnetic pulley separators recently were installed in the foundry of the Rundle Mfg. Co., Milwaukee, manufacturer of bath tubs and other sanitary ware, by the Magnetic Mfg. Co., Milwaukee. The first installation, which is shown in Fig. 2, is employed in a system which prepares sand for two stationary sand slinging machines built by the Beardsley & Piper Co., Chicago. As may be noted in Fig. 2, the sand is elevated from the shakeout on a belt conveyor. As the sand reaches the end of the conveyor line, it passes over the magnetic pulley, clearly shown in the illustration, and then drops into the mill, while the tramp iron, which is separated from the sand, falls into a special container. The installation of the equipment for handling and preparing the sand, removing the particles of iron from the sand, and for molding, has permitted the foundry, with a former output of 90 tons, to increase its output 78 per cent.

The second magnetic separator installation is shown in Fig. 1. The old foundry of the Rundle company, as well as one bay in a new foundry, are operated as a separate unit and are equipped with several tractor type sand slinging machines. When the sand slinging equipment first was installed, it was customary to screen

the sand once a week to remove small pieces of iron, six men being required for this work. However, the mesh of the screen necessarily was such that all of the fine shot would not be retained on the screen. Considerable difficulty also was encountered in tempering the sand after the screening operations, resulting in some casting loss. Recently the installation, shown in Fig. 1, was made, which operates in connection with the sand slinging machine.

Sand is treated by the magnetic separator practically once a week, Saturday afternoons usually being utilized for that work. The operations followed in preparing the sand, when the magnetic separator is used, are as follows: The molds are shaken out and a sufficient amount of water is added to the sand to temper it properly. A sand cutter then is used to throw the sand into a heap which extends the full length of the foundry. Each bay has a separator floor and sand slinging machine. The sand then is handled by the sand slinging machine in the same manner as when molding, except that instead of depositing the sand in a flask, the machine throws it on the belt of the separator unit. It passes over the magnetic pulley, to remove the iron, and then is deposited in a heap at the back of the machine.

As may be noted in the illustration the magnetic separator is mounted on a frame equipped with castors. The unit is attached to the sand slinging machine by chains, and is pulled by the tractor type machine. The separator unit may be picked up by a crane and readily moved from one floor to another. According to Julius Miller, foundry superintendent of the Rundle Mfg. Co., this equipment has resulted in a considerable saving in the cost of removing iron from the molding sand and also has resulted in a more perfect separation.

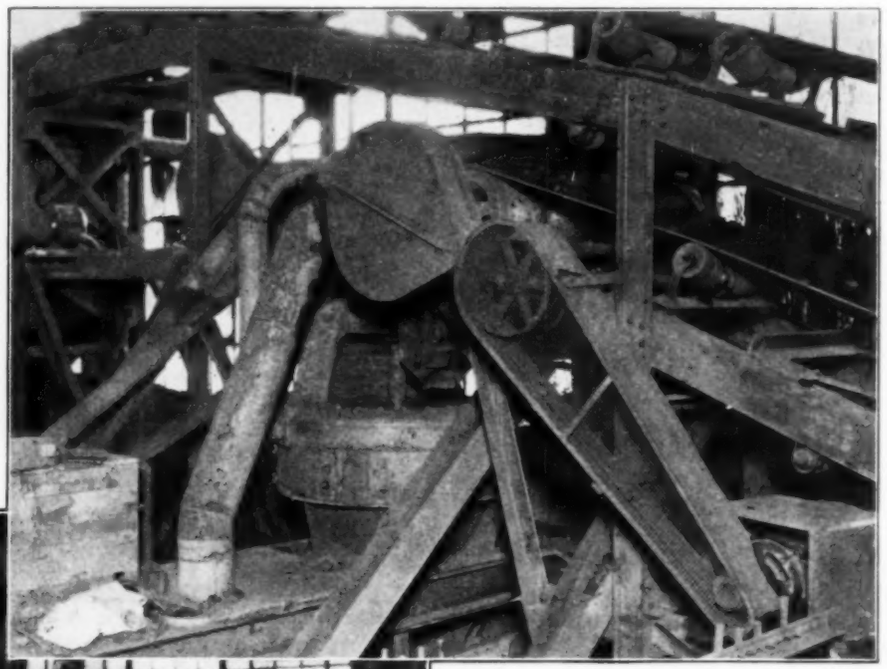
Molten Iron Comes Out of Casting Riser

Question: In making castings for shaft couplings we find that the iron backs up through the riser during the feeding operation. Afterward we find porous areas and actual cavities in the center of the casting when it is bored out for the shaft. We have changed from green to dry sand molds and have poured the iron through every conceivable form of runner top and bottom. We even have tried the small gate and slow pouring method advocated by E. Ronceray in a paper published in THE FOUNDRY a few years ago, but the castings show no improvement. We are wondering now if the fault lies with the iron. We had an analysis made recently with the following result: Silicon 2.15 per cent; sulphur 0.125 per cent; phosphorus 0.59 per cent; manganese 0.50 per cent; graphitic carbon 2.84 per cent; combined carbon 0.20 per cent. We melt the iron with a byproduct coke in which the sulphur averages 0.50 per cent.

Answer: We regret that we cannot prescribe a definite remedy for your defective castings. Apparently you are observing every feature of accepted foundry practice. Therefore the trouble must be due to some obscure cause. A personal examination to check every step in the process would be necessary before we could arrive at a reasonable theory.

The analysis of your iron while not perfect is quite suitable for small and medium size couplings; it is melted and poured hot; the molds are well vented and thoroughly dried and in view of these conditions we cannot explain why the metal backs out of the riser.

There is a possibility that the sand in the mold or in the center core is to blame. Pour a mold without a cope and watch how the iron acts. If it does not lie perfectly quiet, you may rest assured that either the sand is not in a suitable condition or that the pig iron has not been made properly. You might test out both of these theories by radically changing your sand and your iron mixture.



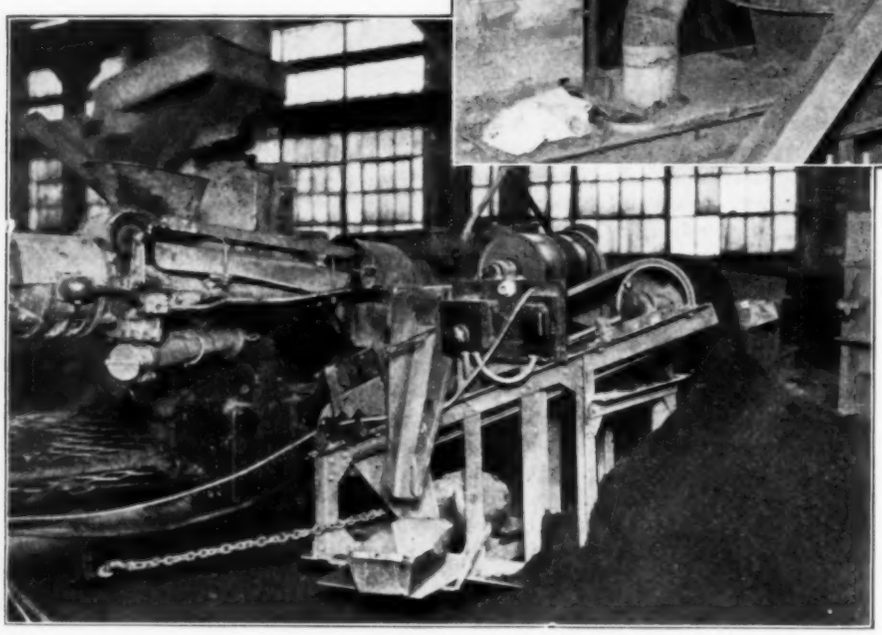


Fig. 1 (Left)—The Separator Unit Is Mounted on a Frame Attached to the Tractor Type Sand Slinging Machine. Fig. 2 (Above)—This Preparing Unit Mixes the Sand for the Stationary Machines

Unexpected Variations *DOMINATE* Steel Casting Practice

By F. A. Melmoth

Part III

WHEN producing certain special classes of work, notably those calling for alloy steels, variables from the composition standpoint cannot be countenanced, owing to the significance of the alloying element on the ultimate service performance of the casting. It is here that the real benefit of electric melting can be appreciated. It is perhaps fair to say that there is no special element used in such steels which is not under more perfect control in the electric furnace than in any other type. With correct slag conditions, which are attained without difficulty, quantities in the casting become merely a question of calculation, as losses are practically negligible.

Production of straight carbon steels accurate to analysis is almost as straight forward a matter in the Siemens open hearth as in the electric furnace, and in this class the latter furnace cannot demonstrate any serious advantages.

In the author's experience the converter, while producing a steel suitable for light castings, cannot be said to attain the regularity of product obtainable from the other two processes mentioned. This is probably due to the fact that the critical period of the blow, which controls largely both character and composition of the product, is short and also entirely in the control of the human deciding factor. This calls for high skill and long experience if regularity is to be assured.

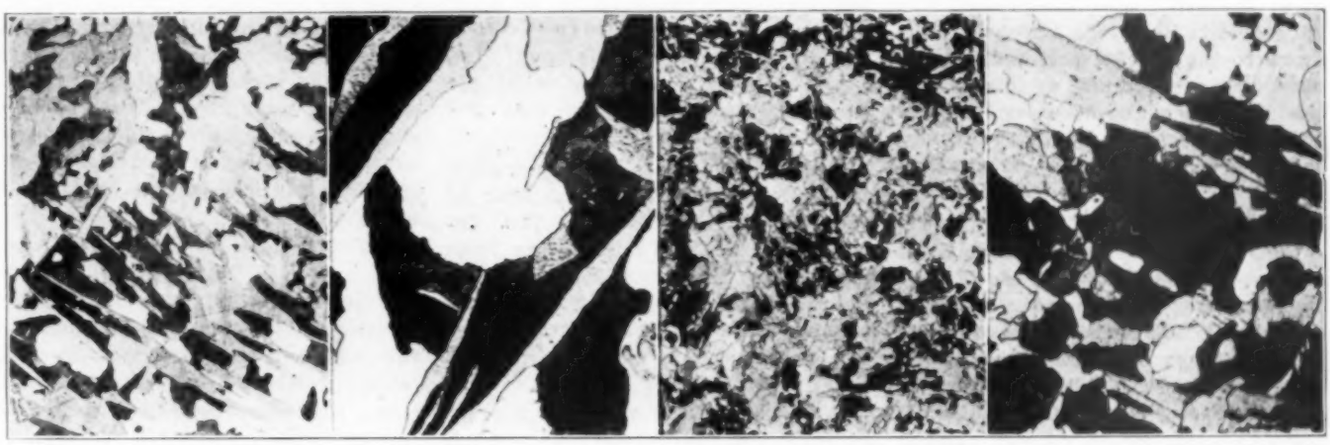
Associated with steel production, and certainly having an influence as a variable is the use of various deoxidizers other than the silicon and manganese content normally present. The use, or more important, the abuse, of such materials, can induce effects in the casting of quite a serious order. At the risk of being accused of platitude, the author would emphasize that these useful materials never should be permitted to become apparent remedies for bad steelmaking practice. They are in no case capable of turning badly made steel into good steel, and their use in such circumstances often produces a condition in the casting which is dongerous.

Taking first the case of aluminum, the author considers it quite possible to produce perfectly sound castings without its use. On the other hand, he always has used it in moderate amounts as a safeguard, principally in green sand castings. He is satisfied that if added in small amounts to previously well made steel, aluminum tends to confer on the steel a certain degree of capability to resist the unbalanced effects of mold gases and water vapor. A charge of steel of a rising nature cannot be corrected safely with aluminum. In such a case large amounts are called for, and the oxidation of the aluminum produces a dirty steel, and ultimately castings much reduced in strength. Such charges should invariably be returned to the furnace and corrected in a proper manner.

Apropos the use of aluminum, the author often has seen it used by placing pieces in the mold, it being intended that the steel should take it up during its passage through the mold. If this is done it is necessary to be sure that the pieces are small and thin. An experience some years ago has made the author afraid to introduce aluminum in this way. Certain castings showed extremely hard spots on the bottom face as cast, and

Concludes Series

THIS is the third and concluding part of Mr. Melmoth's paper on variables in steel casting practice. The author describes the use of deoxidizers in steel and the necessity of heat treatment to obtain the best physical properties. The preceding articles appeared in the June 1 and June 15 issues of THE FOUNDRY.



FIGS. 3 AND 4—UNANNEALED STRUCTURE AT 50 AND 200 DIAMETERS RESPECTIVELY. FIGS. 5 AND 6—REPRESENTATIVE ANNEALED STRUCTURES ALSO AT 50 AND 200 DIAMETERS

it was impossible to machine them satisfactorily. The steel being satisfactory in composition and structure, and the position of the hard spots making it impossible to contemplate segregation, the matter called for investigation. It was found that porosity had been experienced on this bottom face, and with a view to preventing this quite local defect, small pieces of aluminum were placed in the mold. The hard spots were cut out and examined and it was found that they contained anything from 10 to 20 per cent of aluminum. It seems feasible that the chilling effect of the green sand mold had been sufficient to solidify the steel in contact with the mold before complete diffusion of the pieces of aluminum could take place, with, of course, the production of an extremely hard alloy of iron and aluminum.

Ferrotitanium of both carbon-containing and carbon-free types often is used in steel for castings. The author has only used this material in castings made from electric furnace steel, and if added to the furnace and thoroughly absorbed by the bath before tapping some small benefit in the strength of the product was noticeable. However, its cost compared to the benefits achieved did not permit its regular use, as it was considered that equally good results could be obtained at much less cost. In any case, it was considered essential to add it in the furnace, and not in the ladle.

Calcium silicide is another material commonly used as a final deoxidizer. Its use in moderate quantities undoubtedly is useful, but the remarks regarding the use of aluminum apply also in this case. All the materials, while representing useful special additions to steel, are in no way capable of nullifying the effects of poor steelmaking practice, and the degree of their use might even be taken as a measure of the perfection of the steelmaking methods employed in the plant under consideration.

When it is appreciated that no work can be placed on a steel casting with a view to breaking down the coarse cast structure commonly present before heat treatment, it is realizable that this operation is capable of producing many serious variations if inefficiently carried out. Almost all steel castings are submitted to treatment nowadays, and their ultimate capabilities only can be produced by a correct procedure in this operation.

The bulk of general engineering castings are made from mild steel, which in its cast form, slowly cooled in a sand mold, exhibits a coarse, strongly crystalline structure. As might be expected such a condition is coincident with physical properties of a comparatively low order, and very small resistance to shock.

A typical test result of such a mild steel in its sand cast form is shown at *A* in Table II.

Micrographs in Figs. 3, 4, 5 and 6 no doubt will demonstrate fully the reason for the low elongation and impact figures, Figs. 3 and 4 being of the unannealed structure at 50 and 200 diameters respectively, and Figs. 5 and 6 being representative of the annealed structure at 50 and 200 diameters.

Such material does not represent a satisfactory product for the bulk of engineering requirements. The figures given in *B*, Table II, are from tests from the same charge taken after a perfectly straightforward annealing process at 875 degrees Cent. followed by cooling in the furnace as usually practiced.

It will be seen at once that a great improvement has been brought about. Examining the figures in relation to the structure shown in micrographs will show that the removal of the coarse angular crystalline structure has resulted in a large increase in the ductility of the steel, and in its resistance to shock.

A short study of this simple case doubtless will be sufficient to emphasize the necessity for lack of variation in such an important operation. The real physical capabilities of a steel either of the straight carbon or alloy type never are exhibited in its cast form, but are only potentially present, able to be evolved by correct heat treatment properly carried out.

Such treatment will, of course, vary according to the nature of the steel composing the casting, and to some extent also according to the service demand made upon it.

FIGS. 7 AND 8—SPECIMENS OF STEEL IN THE UNANNEALED OR AS CAST CONDITION. FIG. 9—ANNEALED SPECIMEN SLOWLY COOLED

The great majority of specifications for mild steel castings can be met easily by a straight annealing, cooling either in the furnace, or in air, the latter depending principally on the type of casting being handled. Castings with heavy sections obviously would be likely to fracture if quickly cooled and these are cooled almost invariably in the furnace. However, the lighter types, can be cooled safely in air, resulting in a somewhat higher tensile strength and yield point, while ductility remains practically unaffected. If complicated in type, air cooling may be followed by a second heating to a lower temperature, say 600 degrees Cent., with advantage.

While such a treatment will enable any initially good material to conform comfortably to standard specifications, the limits of the capabilities of the steel are not by any means reached. In certain special cases, and where size and design of casting permit, a marked further improvement is obtained by quenching the casting in water or oil from 850

to 900 degrees Cent., afterwards repeating to a lower temperature, say 450 to 600 degrees Cent., depending on the properties desired.

These remarks apply with considerably greater force in the case of alloy steel castings. The real benefits of the presence of the alloys only can be attained by a correctly designed method of heat treatment. Taking the case of a nickel-chrome steel as an example the test result from this material, quenched in oil from 850 degrees Cent. and afterwards reheated to 550 to 600 degrees Cent., gave the data shown by *C* in Table II.

A test of this high standard is, of course, out of the question unless the casting is subjected to a carefully designed and controlled treatment, and the figures are given as a matter of interest, and to show, that even in casting form, subjected to no mechanical work of a structure refining nature, such steels are capable of being put into a remarkably satisfactory condition by heat treatment alone.

Manganese steel, is as well known, depends entirely upon the efficiency of its heat treatment to exhibit its unique properties, and no matter how good the initial material, no success is possible with this product until its treatment is understood thoroughly.

These somewhat sketchy remarks on heat treatment are given with the idea of adding emphasis to the importance of correct treatment, so that the real necessity of suppressing variables will be appreciated. The author is aware that even today, founders not able to avail themselves of expert metallurgical knowledge are likely not to attach full importance to the operation, with the result that their product never can exhibit its capabilities to the best advantage.

The main function obviously is temperature, and as detrimental results follow either too low or too high temperature of treatment, these are the first variables to be avoided. This can be done regularly and satisfactorily by correct temperature control by means of modern instruments. Accurate pyrometers, correctly placed to indicate the real temperature of the material itself, and not the furnace atmosphere only, are an absolute essential.

The length of time required is controlled by the thickness of section involved, and variations in result are not uncommon from a lack of appreciation of this fact.

Faults which can be attributable directly to incorrect manipulation during treatment can be tabulated as follows:

Too low a temperature: The coarse as cast structure is not completely removed, and the physical properties are little affected as compared with those of the untreated product. The solution of the cast structure, and its recrystallization in a much finer form, only can be attained by temperatures above the upper recalescence point of the material.

Too high a temperature: The cast structure is removed, but as the coarseness of the final structure is dependent largely on the temperature from which the casting last cooled, its structure now will be much coarser than necessary, and its physical properties correspondingly lowered. In addition, the castings will be scaled badly, and probably distorted.

Too short a period at temperature: As stated previously, time required is controlled principally by the thickness of section involved, and the result of too short a time for a given section will be that the solution of the cast structure will not have proceeded to completion. The remaining strongly crystalline and angular structure will cause the casting to possess physical results lower than the true capabilities of the material.

Apart altogether from the changes in microstructure with coincident improvement of physical properties in the casting, there are two further directions in which possible variations of result may take place.

The first is that of the action of heat treatment in the removal of stress existing in the casting as received from the mold. These stresses can be of a two-fold character. The first are those induced by variations of section thickness and consequently locally varying cooling speed in the mold, and the second, the stresses resulting from hindrance to the normal contraction when cooling from the molten condition. In effect these may be taken as identical in their action, which, briefly stated, is that they cause the casting to contain, locked up in its crystalline structure, stresses of varying degree, likely as a result of shock or sharp changes of temperature, to fracture the casting. The coarsely crystalline structure, possessing definite lines of cleavage, is susceptible to fracture from this cause, and the refinement by treatment renders it much less likely that stresses will release themselves by fracture. In addition, the slow and even cooling associated with the annealing of heavy or complicated castings removes these stresses to a large extent.

Assuming a steel casting to be of the heavy and complicated type, sure to be in a state of considerable stress as received from the mold, anything which even momentarily can add to these stresses is capable of causing fracture.

A variable, not always easy to control in such cases, is the increasing to the danger point of the stresses by uneven or too quick rise of temperature in the heating up process. In many types of steel, this can easily result in fracture. With such castings it is always safer to put them into the furnace before becoming cold after casting. By this

FIG. 10—MICROGRAPH OF STEEL SLOWLY COOLED FROM ANNEALING TEMPERATURE. FIGS. 11 AND 12—STRUCTURES IN THE AS CAST CONDITION

FIGS. 13 AND 14—ANNEALED STEEL SLOWLY COOLED FROM ANNEALING TEMPERATURE. FIG. 15—SPECIMEN UNANNEALED

means, and by careful and reasonably slow heating, to avoid sharp temperature potential between inside and outside, or between one part and another, it usually is possible to eliminate the risk of fracture due to this cause.

Although the microstructure may be changed perfectly from the coarse crystalline as cast condition to the finer, and less angular and consequently more ductile state by submitting the casting to the correct temperature for a sufficient length of time, it is not necessarily in an unstressed condition. The bulk of the stress removal portion of heat treatment depends upon the cooling period. If this is so fast that section variation can cause material differences in temperature from part to part, unequal cooling stresses are bound to occur. In small castings their effect may be negligible, but in heavy castings it is essential that cooling is perfectly under control, and proceeds slowly and evenly. In some cases it is necessary that this is carried down at this rate to almost atmospheric temperatures, and serious fractures have been recorded when such castings have been removed from the furnace, at a period when the outside appeared to possess no noticeable degree of warmth.

A further feature associated with treatment, but only common in large complicated castings, is that of distortion. During the comparatively long periods these castings are at a high temperature there is always the possibility of distortion by sagging and careful packing is necessary to insure support.

This series of articles does not claim to have exhausted by any means the possibilities of variation which exist in steel foundry practice, but has perhaps indicated sufficient to show that almost eternal vigilance is called for in the manufacture of steel castings if regularity is to be obtained and maintained.

Figs. 7 to 18 are typical micrographs of steel casting structures both as cast and annealed. All annealed samples shown in Figs. 9, 10, 13, 14, 17, and 18 have been slowly cooled from annealing temperature, and are therefore representative of heavy type castings normally treated in this manner. The others shown are in the as cast condition. A shorter period at full temperature followed by a quicker cooling, such as is common to lighter castings, would have produced much finer structures.

Table II

Shows Variation in Physical Properties

Max. Stress Pounds per Square Inch	Yield Point Pounds per Square Inch	Per Cent Elongation on 2 Inches	Per Cent Reduction of Area	Cold Bend	Izad Impact Foot Pounds
A 66,752	33,600	14	18.58	87° broken	15
B 69,888	37,184	26.5	31.58	1 Inch Diameter 180° unbroken ¾″ x ⅜″	36
C 119,168	....	24	52.4	180° unbroken	....

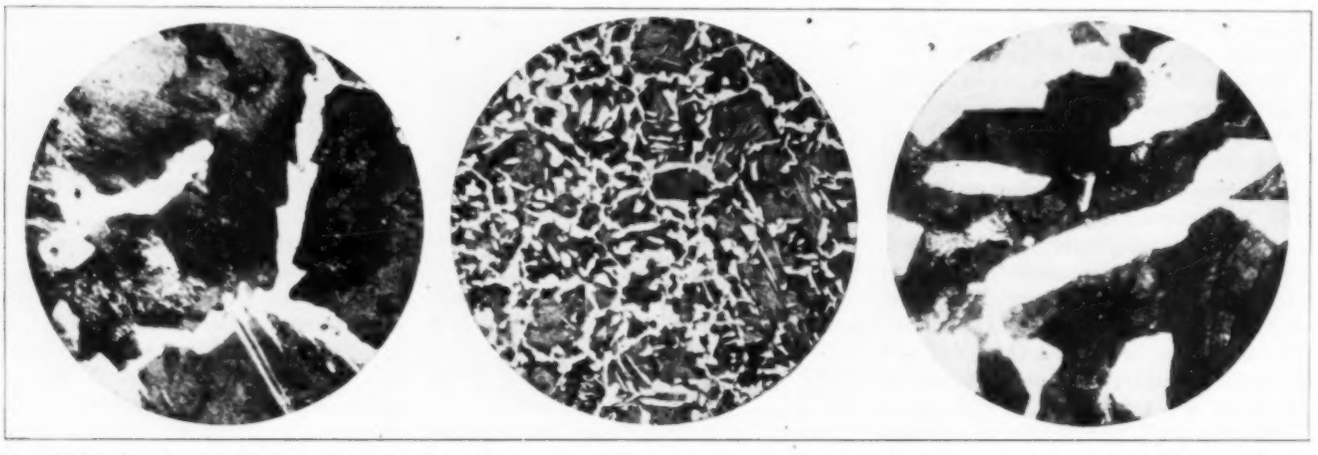


FIG. 16—SHOWING STRUCTURE IN THE AS CAST STATE. FIGS. 17 AND 18—STRUCTURE AFTER SLOWLY COOLING FROM ANNEALING TEMPERATURE

Bill Touches on Some Problems in Molding-IX

By Pat Dwyer

SOME person, some place and at some time made a statement to the effect that he did not care one ring tailed, continental tuppence ha'penny who made the nation's laws if he was allowed the blessed privileges of writing its songs. These may not be the exact words. One's memory at times slips a cog, but if any stickler for accuracy thinks I am going to spend an hour prowling through dusty tomes in an effort to verify the quotation, the aforesaid stickler is to be disappointed cruelly.

So long as the meaning of a statement is given why should one quibble over the exact words, the place, the date or the author's name? For the past year, the hysterical press and a great number of its hysterical readers have tortured themselves, and others, in useless speculation over what a certain eminent citizen intended to do after he publicly had stated he did not choose to run. The master minds could not assimilate the statement in its naked simplicity. They tried vainly to analyze, dissect and chart if for obscure and hidden meanings. They never gave up until after the balloting was over in Kansas City and even yet some of them are convinced he had a double meaning up his sleeve. You and I know better. He said he did not choose to run and he didn't. That is a fairly convincing argument for any person to try to climb over or creep under. The same line of reasoning applies to the statement of the lad who said he preferred writing songs to making laws. Who cares who he was, where he lived, when he said it or what were the precise words he used? The roughneck, the barbarian, the scoffer who has no appreciation for the good, the true and the pure may sneer that he had his eye on the prospective royalties from music publishers and manufacturers of phonograph records, but that base insinuation is knocked in the head by the triumphant statement that this great hearted and patriotic citizen flourished at a period before these modern forms of torture were invented.

"Well," I imagine I hear you say impatiently about this time, "What about it? If you are not interested in this person who wanted to blossom out as a singer and who therefore promptly should have been nipped in the bud, why bring him up?"

I realize exactly how you feel. Many a time and oft, as that jolly old dog Shylock remarked on one occasion, I have been peeved almost beyond endurance by people who, as the saying goes, beat about the bush before coming to the point. One or two words of necessary explanation is or are all I ever allow myself before making a definite statement. A reader's time is valuable and I hold that a writer who wantonly steals that time is just as guilty as the low fellow who snatches a petrified crust from a starving child. More guilty in fact, because he derives no benefit from the stolen time, while possibly he might gnaw the old petrified crust.

Trusting that you still are with me and have not tuned in on any other station I will make the announcement I had in mind when I commenced. A few hasty and irascible reader probably by this time have torn the page out and thrown it away and perhaps that is just as well. This is not written for apoplectic gentlemen who bolt their food, read the head lines and go through life in a series of violent kangaroo hops. I am sitting here comfortably perched on two chairs engaged in setting down these sapient observations and I like to think that the reader, a man of culture and refinement, also is in a comfortably relaxed position, mentally and physically, while reading them. Hurry has killed more people than hard work.

My only reason for mentioning the lad who preferred writing songs to making laws was to illustrate the point that there is no accounting for tastes. If I had started off with the bald statement that I prefer reading books to writing them, you would be justified in harboring the suspicion that an Ethiopian was concealed some place in the stack of lumber. By craftily introducing a sterling and well known quotation as a precedent, the reader unconsciously, automatically and in the most friendly manner accepts the statement at its face value. Some readers, unfortunately cursed with a suspicious nature, probably will claim this admission simply is an evidence of laziness. Maybe so. Maybe so. The point is immaterial. Certainly I have no intention of throwing off my coat and vest and stepping into the controversial ring to do battle with these scoffers. Not during this hot weather, anyway. Later perhaps, in the bracing days of winter when I feel more up to the mark, I may consider the proposition. At present I

He Shot the Bull Every Day from 9 to 11 a. m.

am satisfied with the plain statement that I prefer reading books to writing them. This statement reflects courage of the highest order in these modern days when the entire population over the age of ten is engaged either in writing or in planning some way to break into the big money bestowed on authors of books and scenarios.

A comparatively small number, of which Bill is a shining example, constitutes a third class. Bill has small respect for books or writers. On more than one occasion he has declared boldy that if he had his way he would burn all the silly stories and drown all the goofy authors and in that way make the world a better place in which to live. In the meantime he derives a certain amount of pleasure from criticizing and holding up to ridicule the composition, plot and incidents in any story he happens to read. He came in the other night all steamed up over a recent best seller dealing with the adventures or rather the reminiscenses of a venerable old gentleman on the east cost of Africa 50 years ago when the aforesaid v. o. g., according to his own modest claim, a proper hell raiser on four wheels was engaged in developing a market for the product of civilized nations among the heathens and cannibals. Bill asked me if I had read the story. I admitted that not only had I read it but that I had derived so much pleasure from it that I had sat up until past midnight to finish it. I declared it was the cleverest composition I had seen for a long period and I did not know which part pleased me the more, the plain unvarnished statement of the old man in the first section of each chapter, or his apparently disconnected, but in reality closely knit, illuminating, shrewd and sometimes poetic comment in the second section. Taken altogether it was a wonderful piece of work and bore the unmistakable stamp of truth.

"Truth?" Bill spread his hands in a hopeless gesture. "If that story is true, I'm a hottentot with a copper ring in my snout."

"The copper ring seems to be missing," I admitted, "but that little detail does not invalidate your testimony as a witness for the defense. I'll get you a ring. I'll go a step farther and clinch it in the end of your beak if you promise not to bite me. I am not particularly fussy about the manner in which I die eventually, but I don't want to lie under any tombstone bearing the inscription:

He lost his fingers
Now here he lingers
A victim of hydropho-bi-a

"Don't worry," said Bill. "You'll never die of hydrophobia and as for a headstone, the only one you'll ever lie under will be a grindstone that some exasperated person will hang around your neck before he throws you off the end of the dock. Swallowing that story and declaring that you believe it is true, shows that you have just about as much sense as a kitten who suffers a similar fate. I admit it is a clever piece of work and if it had been presented as fiction I should have enjoyed it, but I cannot tolerate the idea of an author sticking his tongue in his cheek and playing me for a come-on.

He Knew the Man Who Wrote "Rock Me to Sleep"

"Ever since I was a boy that peculiar form of hocus-pocus never has failed to give me a pain in the neck. Nearly all public speakers and writers are cursed with this disease of telling their stories in the first person. One of these lads picks out some story or incident of which he has heard or read and then proceeds calmly to stick himself in as the central figure. 'I remember one time addressing a large meeting in Apahauke and I happened to say so-and-so and some person in the audience yelled back so-and-so—' The story in itself may be funny and it really may have happened at one time, but after I have heard it half a dozen times from half a dozen speakers, each claiming it as his own personal experience, I writhe in agony and feel like crowning the speaker with a paving block."

"You never heard this story before," I interrupted. "The personal story of an old man who spent several years of his youth on the Gold coast."

"I didn't, hey?" Bill inquired loftily. "Say, fella, lissen. Back in the late eighties and the early nineties I read all that kind of stuff in a series of stories written by a lad named Rider Haggard. They were all written in the first person and the introductions were, if anything, more skilfull and plausible than this present story which you think is true. However, at that time the author was plowing a virgin field. His stuff was new and fresh and his publishers did not need to start any extraordinary ballyhoo to have it accepted. The reading public, fed up on the mushy, lackadaisical novels of the period recognized the new note in this adventurous fiction with the scenes laid in a strange land among strange people. They simple ate it up. They smiled tolerantly over the author's first person presentation. They knew the stories were fictitious, but that knowledge did not detract a single hair from the pleasure they derived from reading them. Naturally, after the way of the world, a host of imitators have followed in Haggard's footsteps and cheerfully have pinched his descriptions of the flora and fauna, the habits and customs of the natives. Straining after realism and in an effort to prove their familiarity with the subject, they stick impossible words like M'bwongo and M'wingoopo on nearly every page with what they fondly believe is the English equivalent following in italics, while at the same time nearly every paragraph betrays their pitiful ignorance of the common rules governing the grammar and composition of their mother tongue."

"What have you been doing lately?" I inquired suspiciously. "Have you been sitting up, burning the midnight oil and all that jolly old kind of rot, studying the niceties of the English language? Times without number I have heard you declare that grammar is nothing but a mess of tripe. That the order in which words are arranged does not make the slightest difference so long as the other follow gets your meaning."

"Well," said Bill, "I'll tell you. Like wearing clothes, it all depends on circumstances. A dress suit would excite ridicule in the shop, while that more or less mythical personage, nature's nobleman, would cut a silly

figure at a formal gathering if he appeared in an undershirt and a pair of patched overalls. I prefer shirt-sleeve English under ordinary conditions where a man pours forth his thoughts as they arise in his mind. Where a person writes a book, he or she has no more business turning out a sloppy article than I have in trying to sell a man a casting all fins and wings and bunions.

"Talking about castings," he continued, "reminds me that I have a few more observations to make on methods for molding the trough casting. Where for any reason the foundryman decides to mold the casting in the position it will occupy in service, he has an even greater choice of methods than under the first alternative where the mold was made in the opposite position, that is with the open mouth of the castings on the bottom. Two principal methods are employed depending on whether the mold is made with a dry or a green sand core. In the first method a plain box pattern and plain corebox are required. By plain corebox is meant one with sides and ends without bottom or top. In the second method a complete pattern, a perfect replica of the casting is used. Where chaplets are permissible they may be utilized to support the core in the mold, but usually the core is suspended from the cope or from rails across the top. On account of the tremendous pressure exerted on the core, a corresponding weight must be placed on the top to hold it in place and for that reason the molder in many instances prefers to use a cope instead of adjusting a number of rails or other bars. The cope is all in one piece. It is rigid. The bars placed reasonably close together afford a great number of convenient points for holding the wedges on top of the core. Whether the cope is rammed full of sand is an optional feature and usually depends on the general method followed in making the mold. In several methods, sand is rammed in the cope at one of the intermediate stages. In a few methods the sand is not rammed in the cope until everything else has been done with the exception of making up the runner.

Four general classifications cover all the available methods, but as in methods formerly described, each of the four major classifications is subject to one or more modifications. The four main methods include: 1—Making a complete dry sand core for the interior of the casting. 2—Making a combination dry and green sand core. 3—Making a green sand core in an independent corebox. 4—Making a green sand core in the pattern and lifting it out.

Each method has certain advantages and disadvantages and the selection of any one as the best will depend to a great extent on local conditions and available equipment. For example without a suitable oven, little attention would be wasted on a large dry sand core. Similarly where a customer supplies the pattern made in a certain

From a Rare Old Print "Happy Days"

manner, the foundryman may have to employ a method which he would not favor if given a free hand in designing both pattern and equipment.

Consider briefly some of the details in each of the four methods, commencing with the first which seems to have a slight advantage over the others in the majority of cases. Pattern and coremaking equipment are reduced to a minimum and the mold and core are well within the capacity of the ordinary workman. This point was touched upon before, but its importance is realized by every foundryman who has to adapt himself to conditions and get along without highly skilled men. Even where men competent to mold the casting according to any method are present, the simplest rigging is worthy of attention since usually it reduces the cost.

Patternmaking is held to a minimum by constructing a plain box with sides and ends without a bottom and with a loose cover. A plain sand bed is prepared in the usual manner above a layer of coke and the pattern is placed upon it. The bed must be perfectly level so that in turn the walls of the mold will be vertical. If this detail is not attended to properly it will be difficult if not impossible to lower the core into place later. This fact is so obvious that no necessity should exist for mentioning it, if it was not for the other also well known fact that many molders seem to think that they can level a bed by the eye. Of others who are satisfied if the bubble in the level appears any place in the general vicinity of the center mark.

Cover for the pattern is constructed separately so that it may be removed later while the pattern is serving as a corebox. It is screwed temporarily in place during the molding operation and in that manner helps to brace the sides and ends of the box pattern. Before attempting to ram sand around the pattern, the inside is braced in a suitable manner to prevent distortion. A rigid frame may be employed for the purpose or reliance may be placed on individual pieces of plank and scantlings sawed to the proper length or adjusted through wedges at the ends. A second advantage of using a detachable cover lies in the fact that it may be removed before the pattern is drawn out of the sand. Then a hammer and block are employed to rap the walls of the pattern on the inside. With the clearance secured in this manner the pattern may be withdrawn easily from the mold.

This method greatly facilitates the molding program, particularly where the pattern is knocked together in a hurry without any little niceties of finish or the proper degree of draft on the walls. Where the weight of the castings is an important feature the pattern should be drafted to compensate for the inevitable swell at the bottom of the mold when it is filled with metal. In this particular instance with a pouring head approximately 3 feet above the lowest edge of the mold the casting will come out at least ¼-inch wider than the pattern across the bottom. Where the casting is sold by weight and where the dimensions are not held to close limits the foregoing precaution does not apply particularly since draft is not required to ease the pattern out of the sand.

Under certain conditions the cover may be dispensed with altogether. Thus it is not required in any instance where the cope in whole or in part is not rammed directly over the pattern. The only function then remaining for the cover is to prevent sand from falling down inside the pattern. A large bottom board or a number of smaller boards will answer.

WHICH Should Apply —THEORY OR PRACTICE?

By John Shaw

Part III

SOME light is thrown on the effect of the size of test bar in a paper by Dr. Klingestein. A chart is given showing the relation between physical properties to bar size and composition. From the diagram it may be seen that when using two sizes of bars cast from the same mixture, with 6.7 per cent total carbon and silicon, the 20 millimeter diameter bar gave 4.75 tons (10,640 pounds) transverse more than the 30 millimeter bar; with total carbon and silicon 5.4 per cent: the 30 millimeter bar broke at the original figure of the small bar, but the latter was still the 4.75 tons (10,640 pounds) stronger. However, with total carbon and silicon at 4.8 per cent, both bars broke at approximately the same and highest result attained.

Bolton found the larger bar much more sensitive to small variations, hence it would be best to try out both the new British Engineering Standards association's bars, ½-inch and 2.2 inches in diameter. This may add to the difficulty with crucible melting, but with the known lack of homogeneity in cast iron, no other course is advisable.

Size of the molding box, number of bars per box, and that the sand be dried are of importance if comparable results are to be obtained. Take only three recent examples, Bolton, Maurer, and Hamasumi. The first two give a heating and cooling curve of the sand in the box. Bolton also shows the cooling curve of the bar on the same graph. Bolton's bars would be made in accordance with the American standard, viz: two 1¼-inch diameter bars cast in a box approximately 10 inches square, top run and made in dry sand. The heating curve of the sand shows a quick rise to 112 degrees Cent., an arrest while water in combination is driven off and the sand attained its highest temperature of 338 degrees Cent., after 330 minutes. The temperature of the bars had by that time dropped to 676 degrees Cent.

Maurer cast three 1.2-inch bars in a core only 4⅞ inches in diameter. This mold attained its highest temperature of 340 degrees Cent. in 30 minutes and then steadily dropped. The difference in time is accounted for by the difference in method. All three of Maurer's bars were within ¾-inch from the outer edge of the mold and had only 2⅛-inch centers radially, so the mold would heat up much quicker and also dissipate it quicker, due to the small size of the mold.

Is Last of Series

THIS is the third and concluding article of the series that comprised the paper presented by Mr. Shaw at the Philadelphia convention of the American Foundrymen's association, May 14 to 18. The author discusses the effect of the size of test bar, and a number of reports of cast iron failures.

A comparison may also be drawn between the conclusion of Bolton and Hamasumi. The latter states that it took approximately 5½ minutes for the 1¼-inch bar to cool from the euctectic arrest point to 900 degrees Cent. Bolton took approximately 40 minutes for his bars to do the same. Here again the difference in procedure will account for the large variation. Hamasumi used a box 8 inches square, cast in green sand and one bar in a box.

These large variations in cooling rate must have some influence on the structure of the bar, and only shows the futility of comparisons unless some well-defined plan generally is agreed upon.

All the points dealt with in this article could be further elaborated, but it is too long now. The author had three definite ideas in producing this article:

First—To show critics that the problem is not the simple one their criticism implied.

Second—That while the method of approach from a pure iron base was probably the best for steel, and even for cast iron in the first stages, no serious advance has been made along these lines since 1913, and the time has arrived for tackling the full problem.

Third—A definite scheme is suggested. It may be crude, but would at least form a basis for discussion and improvement.

The previous articles have dealt somewhat hurriedly with the theoretical side. There is a much more serious issue that all practical founders must face if they are to regain lost ground, that is, the improvement and reliability of the material generally. Every time a casting goes out that is not right and without the knowledge of the buyer, the seller not only penalizes himself, but lets the whole trade down and adds to the lack of confidence in the material.

The author has spent considerable time studying the technical reports of the British Engine, Boiler & Electric Insurance Co. for the last 12 years. Too much praise cannot be given to these carefully prepared reports. Examples of various types of failures are given, together with the cause, with a view to avoiding a recurrence in the future. So far as the steel side is concerned, the author of the report displays a thorough knowledge of his subject. The various micrographs, tests, and sketches prove this.

With cast iron it is evident the author is not too conversant, and there appears on the surface an impression that cast iron is an unreliable material, and the sooner it is replaced the better. No analyses are given and only one set of test bars,

and not a single micrograph is shown. With some of his conclusions one can hardly agree. To quote one, No. 2458, April 3, 1917, "Killed, Injured. Cast iron heated oven. Composed of two hollow rectangular tables. The shelves were 2—11 x 1—8 x 3 inches overall externally. The top and bottom plates, which averaged 9/16-inch thick, were strengthened by two rows of stays 1⅛ inches in diameter, cast in position, pitched about 6 inches centers.

"Steam at 120 pounds pressure was admitted by a 1½-inch pipe into the upper shelf. This casting was tested to 240 pounds." Yet after 11 years with steam daily at 120 pounds it was stated, "That the *strains produced in the process of casting* had in the course of years resulted in the development of defects leading to the ultimate failure of the stays." Testing to 240 pounds was more likely to cause incipient fracture, but a more likely cause would be the *breaking* action over 11 years expansion and contraction. This is not written in any carping spirit. It is recognized that it is equally to the advantage of the insurance company and the ironfounder to reach the correct reason for failure, to avoid it in the future. How much fuller information would be appreciated goes without saying. Several of the failures in oil and gas engines would form an excellent basis for discussion at the various foundry branch meetings, were the reports given more in detail, such as analyses, micrographs, and tests. Such discussions would be helpful to all parties concerned.

While it is not possible to comment on the hundreds of reports given there is some consolation to be derived from the fact that, though there were numerous cases of molding faults, there were few failures due to metal alone in the higher grade machines, not near so many as steel, with wrong heat treatment and slag inclusions.

If we take turbogenerators and other electrical machinery, out of over 100 reports there are only three relating to cast iron. The first was due to wrong design, where a turbine built in 1912 had two stiffening ribs on the outside. These formed a source of weakness, owing to the slight "breaking" of the casing, and commenced to crack on the outer edge. When cut away, the cracking stopped. In 1926 a report is given of a 1500 kilovolt-ampere impulse type turbogenerator, working at a pressure of 160 pounds pressure and a superheat of 300 degrees Cent. After five years cracks were noticed at the high pressure end, as shown in the Fig. 11. The writer states, "cast iron is at no time the most suitable material for use with steam at high temperatures and less with a complicated casting." Yet the fact remains there are many turbines working at equal temperatures, with no sign of failure. Would it not have been better to get down to the root cause?

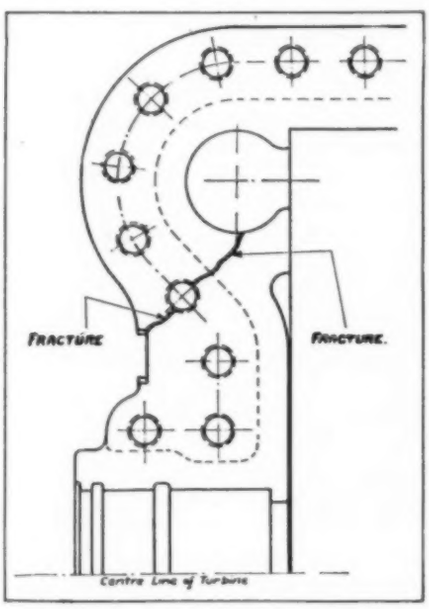


Fig. 11—High Pressure End of Impulse Type Turbogenerator Showed Cracks After Five Years' Service

Present Two Cases

In steam engines and pumps much of the trouble was due to faulty design, and neglect in working. Only two definite charges were made against cast iron as supplied. (1) Cracked cylinder, after running 18 years "The trouble owed its origin to stresses set up when the part was cast." (2) A broken valve seat, part of which found its way into the cylinder and caused damage. "The fact that cast iron is an unsuitable metal for superheated steam is well known; the present case, however, illustrates a more serious danger than the mere failure of a cast iron part, which may result from the injudicious use of that metal." Both of these conclusions are more than debatable, and, considering the thousands of similar engines that have been running many years, one would have liked some more reasoned explanation than a mere statement.

Failures in gas and oil engines are more serious from the founders' point of view. Fractured breech ends, cylinder jackets, and water jackets are far too frequent. While quite three-fourths are due to the

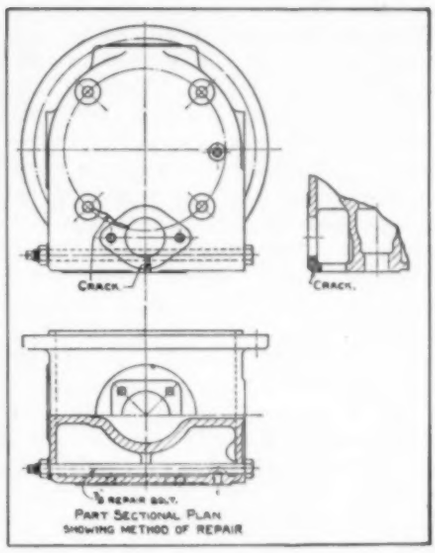


Fig. 12—Expansion Stresses Cause Cracks Which Temporarily Were Mended by Drawing Together with a Bolt

use of unsuitable cooling water scaling up the water spaces, causing overheating, also to bad design, there are sufficient left to call for serious research both metallurgically and from the point of design. That in many cases failure is due to wrong analyses, goes without saying, else how is it so many stand up to the variation in expansion between the inner and outer casings? This is a case where test bars are almost useless and where the composition must be controlled to suit the design of the cylinder, especially where there are narrow jacket cores. An example was given in THE FOUNDRY last year, where a 25-ton jacket cylinder, owing to the heat retaining qualities of a thin jacket core, the combined carbon was reduced to 0.05 per cent with a brinell hardness of 89, while a bush cast from a similar metal showed 0.55 per cent combined carbon and a brinell hardness of 138. Discussing Fig. 12, which temporarily was mended after cracking owing to expansion stresses during the working, the writer states, "Even with a carefully considered design, the metal is only able to withstand the stresses imposed on it, when the greatest care has been excercised during its casting, special attention being necessary in fixing its composition and in carrying out the mixing and pouring." With this dictum we are in perfect agreement and from the fact that there are thousands of gas and oil engines at work, goes to prove, that difficult as the job may be, a fair amount of success is attained and it is shown how vital it is that the true cause

of the failures should be known. Complete analyses, micrographs and tests should be taken and investigated as in steel. Take, for example, a broken crank shaft. Two photographs are given, sulphur prints, micrographs showing excessive grain size, the result of incorrect heat treatment, and the full analysis. The tensile tests giving limit of proportionality, yield point, ultimate stress, elongation, reduction of area; stress diagram, ingot test. Compare with this the vague reference made to cast iron.

No failures were reported in lifts and cranes due entirely to cast iron.

Explosions are by far the most serious from the founders' standpoint, because of the number of accidents that occurred due to material that had no right to have been sent out, causing loss of life and injury. There were 24 cases where pipes, valves, steam chests, etc., were out of section, causing a loss of 14 killed and 17 injured. "Rectangular chest 5/16 to ½-inch one side, 1-inch on the other, "Cast iron tank should be ¾-inch, varied from 3/16-inch to ⅝-inch," "Cast iron pipe ⅝-inch one side, 1 3/16-inch other," "Main stop valve 22/32-inch one side, 1 3/16-inch other," are a few of the worst examples. There is no excuse for failures of this type and, although the casting stood up to its work for a good number of years, the continual stresses set up by the variation in heating and cooling of the thick and thin side, eventually must lead to failure.

Another phase that comes out clearly from these reports is the thoughtlessness of works engineers with regard to both design and the pressures they put on to some castings. The severe screwing up of flanges with only a narrow thick packing between, the replacement of a few cast iron pipes with steel ones in a long range of pipes, with no arrangement for the extra expansion due to the double expansion of steel, taking a valve or tank from a low pressure main and inserting one with a much higher pressure, and many more matters of this sort. More than half the failures were due to water hammer and this was a fruitful source of failure in both steel and copper pipes.

In conclusion, we ask the engineer to consider his side of these useful reports. He should place his orders for any castings under pressure with a reliable firm which has metallurgical control, insist on a rigid inspection, pay a fair price to cover this inspection, and also the extra control in the foundry. We would ask the founder to inspect the product carefully before leaving the works, and see that a suitable composition is used for all pressure work, even pipes. If the standard mixture is not suitable, make a special charge or two, and if this is against production, either obtain a price to cover the extra expense or refuse the order. We, none of us, like to do this, but if we are to regain confidence we must face the difficulties. To the author of these excellent reports we would again urge that he give us the fullest information. The research committees of the American Foundrymen's association would render aid for any failures of American material, of which we noticed one or two, while we know the British Cast Iron Research association would be more than willing to give assistance with British work.

Cupola Does Not Melt at Rated Capacity

Question: We will appreciate your opinion on why our 60-inch cupola does not melt up to its rated capacity. Our heats run from 30 to 35 tons approximately half semisteel and the other half gray iron. The iron charges weigh 3000 pounds separated by 300-pound splits of coke between the gray iron charges and 350 pounds between the semisteel charges. We use 2400 pounds of coke on the bed which extends about 28 inches above the tuyeres. The top of the slag hole is level with the bottom of the tuyeres. Slag and coke freeze in front of the tuyeres after the cupola has been running about an hour and the melting speed decreases. We have tried various kinds of brick in the melting zone but they burn away to an abnormal extent every heat.

Answer: From the data given, we are at a loss to account for the erratic behavior of this 60-inch cupola. On paper every feature is perfect with the exception of the slag hole which is at least 3 inches too high and the blower whose capacity is not given. A 3000 pound charge of iron is quite normal for a 60-inch cupola and 300 pounds of coke should be sufficient between charges. Limestone to the extent of 50 pounds reinforced with a few pounds of fluorspar should form a liquid slag, but the slag hole should be lowered so that the slag will have an opportunity of flowing away before it is chilled by the blast.

A possibility exists that perhaps you are accepting a guess from the cupola tender instead of actually checking conditions for yourself. Also coke varies in weight to some extent depending on its origin and the size of the pieces and it might be advisable to measure the height of the bed once or twice to check it against the weight. Coke settles down after it has burned for some time and the top of the bed should be 30 inches above the tuyeres when the time comes to charge the iron. *Then* a charge of coke should be added similar to the charge placed under each succeeding charge of iron. We have known instances where the bed was measured before the fire was lighted on the assumption that no change in the height would take place later. With an adequate bed you will be in a position to cut down on the coke between the charges, but proceed cautiously.

A possibility exists that your blower or motor or both are not capable of delivering sufficient air to operate a 60-inch cupola to its rated capacity of 15 tons per hour. In that event your only problem is to adjust your charges and other operating details so that the iron will be hot and the furnace will be clean irrespective of the speed. Brickbats or split bricks should be used to repair the wall at the melting zone at any point where it is burned away to a depth of 2 inches or more. It is not advisable to attempt a perfectly straight wall repair job. A lining will not burn so badly if it is slightly boshed in the beginning.

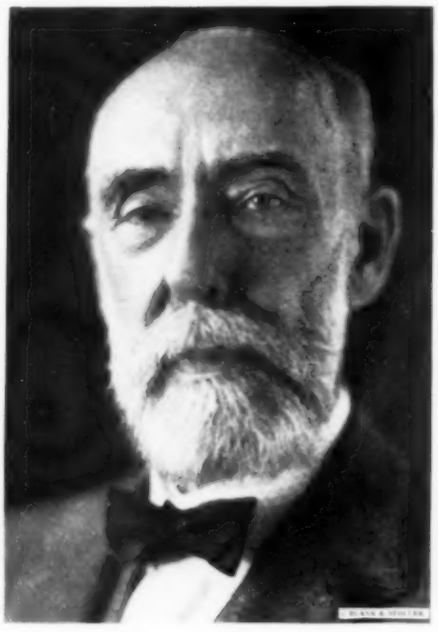
Clow Secures Control of Pipe Plant

James B. Clow & Sons, Chicago, manufacturer of cast iron pipe, radiation and plumbing supplies, has purchased a controlling interest in the National Cast Iron Pipe Co., Birmingham, Ala. The latter concern will continue to operate under its present name with no changes in policy or personnel.

James B. Clow & Sons was incorporated in 1894. Plants are located in Chicago, Coshocton, O., and Newcomerstown, O. The capital stock consists of $750,000 of common and $1,000,000 7 per cent preferred stock.

The National Cast Iron Pipe Co. was incorporated in 1912 and manufactures cast iron water and gas pipe and fittings at its Tarrant, Ala., plant. The company has 10,000 shares of $100 par capital stock outstanding.

The FOUNDRY Family Photograph Album



Upper Left

C. D. CAREY

American Steel Foundries, Verona, Pa.

Lower Left

W. HULICK

Warren Foundry & Pipe Co., New York

Upper Right

W. L. GOETZ

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.

Lower Right

E. B. SHERWIN

Chicago Hardware Foundry Co., North Chicago, Ill.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 724)

Hysteresis (*Hysteresis Coefficient*)

Loss of magnetism due to some molecular change and evidenced by evolution of heat. It is due to the lag of magnetic induction behind the magnetizing force. Also called *magnetic hysteresis.*

It is stated generally as the dissipation of energy in any cycle of operation. This is a loss of magnetism while the hysteresis mentioned under thermal properties is loss of temperature.

Examples:

	Ergs per cu. cm. per sec.
Soft steel	0.009
Hard cast steel	0.025
Soft cast steel	0.013
Annealed cast steel	0.008
Pure iron	0.003
Cast iron	0.013
Alloy steel	0.0006—0.013

These values are obtained from the formula:

$$W_h = n\,fB^{1.6}$$

W_h=Loss in ergs per cubic centimeter per second. (Hysteresis).
f=Frequency in cycles per second.
B=Maximum induction and is taken here as 10,000 gausses.
n=Hysteresis coefficient.

Alloy

A compound of two or more metals usually produced by fusion. Carbon, manganese, silicon, nickel, chromium, vanadium, molybdenum, cobalt, copper, lead and aluminum are the most common alloying elements of the ferrous alloys. When two elements or substances are mixed together but no action takes place and each retains its complete identity, the combination is said to be a *mixture.*

If they combine in varying proportions forming a new substance with distinct properties different from either of the constituents they are said to be in *solid solution.* However, if they combine together in some definite proportion they are said to form a new *chemical compound.* In the case of metals and alloys these compounds are called *inter-chemical compounds.*

An alloy may contain any one, any two, or all of the above described. For example, the alloy may be all solid solution, or it may be composed of a mixture and a solid solution or inter-metallic compounds, etc.

Alloy Cast Iron

Cast iron alloyed with some other metal, usually the rarer elements, such as nickel, cobalt, tungsten, titanium, etc. Alloy cast iron only has been introduced recently to any extent, but it is considered as having great possibilities for certain uses.

(*Continued on Data Sheet No.* 726)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 725)

Blowy

The property attributed to oxidized steel. It is steel full of gas pockets as a result of large quantities of dissolved gases in the liquid state due to improper melting or incomplete deoxidation. The metal is also termed *wild.*

Wild, Cold Wild

Molten metal is said to be wild when it boils or will not remain quiet due to escaping gases which have been absorbed during the melting operation and which have not been taken care of by the deoxidizers. Wildness can result either from insufficient deoxidation or too much. When the temperature of the metal is too low for the purifying reactions of the deoxidizers to take place the metal is sometimes termed *cold wild.* This applies particularly to cast steel.

Chill

Hard iron structure produced by casting against a cold metal surface. This effect is not noticeable in cast steel. Chill on cast iron varies from ⅛ to 1¾ inches in depth depending on composition, size of chill, thickness of casting, etc.

This is essentially an extremely rapid cooling of the surface of a molten mass from the liquid state. Chilling is done usually in metal molds and certain cast irons chill more readily than others, giving a surface of great hardness which will take a high polish. Such castings as car wheels, chilled rolls, rock crushers, bomb proof protectors, etc., make use of this important property.

The best chilled iron is made in the air furnace with low phosphorus and sulphur content. The following table gives the depth of chill for different silicon contents.

Silicon in mixture....	1.20	1.10	1.00	0.90	0.85	0.80	0.75	0.65
Silicon in casting	0.90	0.80	0.70	0.60	0.55	0.50	0.45	0.35
Depth of chill, inches	½	⅝	¾	1	1¼	1⅜	1½	1¾

Cold Iron

In foundry work cold iron is iron which is thick and sluggish and does not pour readily on account of being at too low a temperature. Cast iron at a low temperature in a blast furnace is usually higher in sulphur than normal and also is termed *cold iron.* In the bessemer process iron which is low in silicon is sometimes spoken of as *cold iron.*

Cold Shut

This is the property of cast metals to flow together but not to weld thoroughly, forming a crack or seam in the casting.

(*Continued on Data Sheet No.* 729)

German Foundrymen Meet in Danzig

By Hubert Hermanns

(German Correspondent, THE FOUNDRY)

One of the Oldest Hoisting Cranes in the World Is Located in Danzig. It Was Built in 1443 and Is Driven by Large Treadmills

THE 1928 meeting of the association of German ironfounders (Verein Deutscher Eisengiessereien) was held in Danzig, from June 14-17. Dr. Werner, president of the association, acted as chairman during the meeting. The technical sessions of the meeting took place in the German technical high school. The first paper was read by Professor Aulich, on the "Principles of Testing Molding Sands." There was no discussion of this paper, but it was interesting to note that the author stated that he always has used the apparatus of the American Foundrymen's association. At present all German molding sands are tested systematically in accordance with the American methods to determine the composition of the sand, the size and form of the grains. More than 200 samples of sand already have been tested, and when this work is finished it is intended to classify all German foundry sands according to their properties. O. Ebling, drying-oven committee of the association, then reported on the results of the committee's investigations. Twenty-three tests had been made on drying ovens, and according to the results of these tests the thermal efficiency of drying-ovens generally is poor. The committee has not yet completed its work, and now intends to test high-pressure drying-ovens and electrically-heated ovens. It also intends to investigate the ability of heated gases to absorb water.

A paper on "Cast Iron With Improved Properties" was presented by Dr. Jungbluth, who stated that the properties of cast iron can be improved by five methods: Alloying the cast iron with nickel or nickel-chromium; producing cast iron with pearlitic structure; improving cast iron by decreasing the carbon content; superheating the cast iron in the electric or oil-fired furnace, and degasifying the cast iron in a fore-hearth by jolting. Further problems to be solved are concerned with the tensile properties, the formation of piping, and the resistance to wear of cast iron. Opening the discussion, Dr. Werner said that all problems relating to the improvement of the properties of cast iron would be solved more quickly if the German foundries producing high-quality cast iron formed a joint committee to investigate this material.

Mr. Staehler stated that, in his opinion, iron with under 3 per cent carbon is no longer a cast iron. Dr. Bardenheuer replied that the character of a cast iron is partly independent of the carbon content. A cast iron is characterized by the graphite and total carbon content can be under 2 per cent. The best strength results are obtained with a carbon content of about 2.6 per cent. Mr. Scharlibbe cautioned against the publication of abnormally high strength values for iron castings which could be obtained only under extremely favorable conditions. The consequences of such publications are unreasonable demands from the part of the consumers; but, in his opinion, it is possible to obtain carbon figures of 3.0 to 3.2 per cent also in the practice of the average foundry. According to Dr. Bardenheuer, the principal difficulties in the production of a low-carbon cast iron are found in the pouring of such an iron. These difficulties have induced Emmel to abandon the extremely low carbon contents. At present the Emmel process uses carbon contents of from 3.0 to 3.5 per cent. Mr. Schmidt pointed out that the properties of iron castings depend not only on the fluidity of the iron, but still more on the rate of solidification of the castings in the mold.

Dr. Thaler read a paper on the "Effect of the Control of the Blast Furnace on the Properties of Pig Iron," and referred to parallel investigations in the United States. Among the factors that influence the blast furnace product the author mentioned the temperature of the blast, the quantity and nature of the slags, and the composition of the burden. All these factors can be changed by the blast furnace superintendent, but moderately. In the opinion of the author, the scrap does not influence the properties of the pig iron in an injurious sense. At present there are tests made in Germany to systematically investigate the effect of from 0 to 50 per cent scrap additions to the blast furnace burden on the pig iron.

In the discussion Mr. Scharlibbe said that doubtless there are many unfounded claims of the foundries concerning the quality of the pig iron as supplied from the blast furnaces. However, a good deal of improvement could be looked for in this direction.

Dr. Geilenkirchen pointed out that the association of ironfounders with a committee of blast furnace superintendents, have agreed upon joint specifications for the delivery of foundry pig iron. Apparently the specifications are unknown to many of the two parties, with the result that they are not used.

Dr. Jungbluth presented a paper on "Research on the Growth of Cast Iron." Two committees are investigating this problem in Germany, one formed by the German iron and steel institute (Verein Deutscher Eisenhuettenleute), and the other by the association of German ironfounders (Verein Deutscher Eisengiesserein). Both committees are working independently, and results will be compared later. Mr. Scharlibbe asked the author whether the program for the further research work on the growth of cast iron will comprehend also the effect of the flow of superheated steam. In his opinion, the influence of flowing superheated steam on the cast iron is much greater than that of static steam. It is noteworthy that diesel engines do not present as many difficulties as steam turbines. The author replied that the actual program does not include such investigations.

Investigate Steam Effect

Dr. Brinkmann stated that at the present time extensive investigations are made upon the influence of flowing superheated steam by a well-known German steam-turbine firm. In the experience of Mr. Meyersberg there is no doubt that the growth of cast iron is affected by the silicon content. Dr. Jungbluth said that, in his opinion also, the chemical analysis influences the growth of cast iron. Obviously these effects are covered by other phenomena. According to information from Dr. Geilenkirchen, there is a third committee investigating the relations between superheated steam and the growth of cast iron. This committee has been formed by the association of German manufacturers of steam turbines.

A paper read by Dr. Bardenheuer gave a description of a "New Horizontal Cylindrical Melting Furnace for Cast Iron," and gave the results of tests which have been made by the author with this furnace, which is heated by pulverized coal. At present the furnace is charged by hand, but the designs for a new furnace provide for charging the furnace mechanically. The tapping hole of the furnace is in the cylindrical wall, so that by tilting the furnace all or part of the metal can be tapped. The most important advantage of the furnace claimed is that the molten metal is covered by a protective slag layer during the entire melting period, so that the metal is never in contact with the furnace gases. During the melting period the furnace is shaken continuously. Principal advantages of the furnace claimed are: Bath is not affected by the furnace gases; the charge is melted rapidly; high melting temperatures allow the production of cast iron of high strength and the pouring of thin-walled castings; low melting costs; addition of high percentages of steel scrap to the charge for reduction of carbon content; chemical composition and temperature of metal are uniform.

In the afternoon session papers of a more general character were read. Mr. Hemprich gave a survey on the development and present state of the Danzig dockyards. After a paper by Professor Dr. Heuser, German technical high school, Danzig, on the "Present State of the Mechanization in German Agriculture and Future Possibilities of Its Development," Dr. Jungbluth gave a summary of the present position of the production of cast iron and malleable iron for agricultural machines and implements. He stated that the German foundries are making a material which compares to that made and furnished by the American foundries.

Dr. Geilenkirchen reported on "Present and Future Problems of the German Iron Foundries." He showed the necessity of reducing production costs in the foundries by improving the thermal efficiency of the cupola and drying-ovens, producing iron castings with best mechanical and physical properties, improving the design and construction of the cupola and its appliances, by a more specialized production of the foundries, and by an equipment of the foundries through which the flow of the materials through the foundry can be accelerated and the handling costs reduced. At the Sunday session, which was devoted exclusively to the internal affairs of the association, the Siegfried Werner medal was presented to August Diefenthaeler for his service to the technique of the foundry industry. At this session Dr. Werner announced the participation of the association of German iron founders in the international foundry convention in London in 1929. The special exhibit of the association will be entitled "Economy in the Foundry."

To Secure Close Grain

Question: We made two cast iron shafts 10 inches diameter designed to be turned and polished all over. One was condemned because the grain was too open and the second was only accepted under protest. They were poured from a mixture of the following analysis: Silicon 1.39 per cent, manganese 0.85 per cent, phosphorus 0.375 per cent, combined carbon 0.61 per cent, sulphur 0.10 per cent. We propose trying a 20 per cent steel mixture in the next pair of castings to show the following analysis: Silicon 1.57 per cent, manganese 0.54 per cent, phosphorus 0.44 per cent, sulphur 0.10 per cent. We shall appreciate your opinion on this mixture. Also will you kindly explain why a casting 2 inches thick will show a close grain, while a 10-inch casting poured from the same ladle will show an open grain.

Answer: We wonder if you have not inadvertently transposed your analyses. You state that the iron showed an open grain with a silicon content of 1.39 per cent and yet you anticipate a closer grain with an iron showing 1.57 per cent. You do not give the diameter of the cast iron shaft and we are left to infer that it is 10 inches. If that is the case you want an iron with little over 1.00 per cent silicon. Space limitations prevent a dissertation on the effects of the different elements in cast iron under an almost limitless number of combinations. However, for your present purpose it may be sufficient to state that the *grain* of iron depends on the relative amount of silicon and carbon plus the time of changing from a hot liquid to a cold solid state. The greater amount of combined carbon in the iron, the smaller the grain and consequently the harder the iron. Silicon has a tendency to promote graphitic carbon in iron and naturally the longer the iron is in the state of transition, the more marked will be the effect of the silicon on the carbon. This explains why iron of the same analyses in the charge or in test bars will show such a wide variation in physical appearance when cast into castings of different sections. In the case you cited the iron poured into a casting 2 inches thick cooled in a definite period of time. The grain of the casting was close. The same iron poured into a 10-inch casting cooled much more slowly and as a result less of the carbon remained in the combined state. If you had gone one step farther and poured some of the same iron into a casting ½-inch thick and made in green sand it would have been chilled white all the way through.

How and Why in Brass Founding

By Charles Vickers

Desires Harder Alloy

We are having some trouble with safety pop valves, seats and disks. We make them out of good steam metal but they do not appear to be hard enough to suit the machine shop. The alloy is copper, 87 per cent; tin, 8 per cent; zinc, 3 per cent, and lead 2 per cent. Could you suggest a mixture that is better for the purpose? Would an alloy such as copper, 88 per cent; tin, 8 per cent, and zinc, 4 per cent be more suitable? We have been adding 2 ounces of 15 per cent phosphor copper to each hundred pounds of alloy. What is wanted is a good stiff metal that will be solid.

As we understand the subject what is wanted is a harder alloy than the one now being used. The substitute alloy mentioned contains the same amount of tin as the first alloy which is too soft. Therefore, it will be no better for the purpose as it will be no harder or stiffer. The small lead addition to the first alloy will have no effect on the hardness. It assists the machining qualities because it causes the chips to break up, instead of coiling in long curls. While the second alloy will be no harder than the first, it might be well to try it before making any radical change, as the word hard as applied to a nonferrous alloy does not mean the same to all minds. Thus the machine shop will call copper *hard* simply because it is hard or difficult to turn in a lathe. Copper is a soft metal, but it is so clingy that it is difficult to work with machine tools because it is tough. All tough, or ductile metals are difficult to work, even pure aluminum.

It follows then that in the event of a mistake in regard to what really constitutes hardness, the second alloy might be considered *hard* enough as owing to the absence of lead it will turn and otherwise work in machine tools with more difficulty. Should this not be the case there is nothing for it but to add more tin keeping in mind however the fact that every one per cent of tin that is added to a mixture of nonferrous metals, means a serious increase in price to the brass founder, and necessitates an adjustment of the price at which the castings can be sold. A suggested alloy for your purpose is the old reliable of the metallurgists: copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent.

Wants Bearing Metal

We are called upon to furnish bronze bushings for bearings which have to withstand an operating temperature of 300 degrees Fahr. We made some bushings of the following alloy: Copper, 83.79 per cent; lead, 3.95 per cent; tin, 5.79 per cent, and zinc, 5.39 per cent. These bearings after being run for some time at a temperature of 70 degrees Fahr. show no fault. Next the thrust load on the shaft was increased until the temperature of the bearing approximated 300 degrees Fahr. The bushing was then examined and was found to contain small surface cracks, which are visible in the larger bore of the casting. These cracks are undesirable on account of the resulting loss in accurate clearance between the bushing and the rotating shaft. We send you a sample casting so that you may understand the difficulty and ask your advice as to what bronze would be most suitable to avoid action of this kind under local changes of temperature. If the bronze you suggest should have any heat treatment will you kindly advise?

The alloy that is being used is too low in lead and too high in zinc to be suitable for this kind of service. It is a common red brass and not a bearing alloy, and from the appearance of the casting sent we would consider that considerable iron is mixed with the brass. This would cause scoring of both shaft and bearing and possibly cracking. It is probable that a bearing alloy would stand up perfectly, and one that suggests itself is copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent. The problem also can be solved in another manner. The present alloy which looks as though it was made of low grade scrap metal, and so ought to be quite cheap compared with 80-10-10, could be used if the large bore was bushed with an alloy of copper, 65 per cent; tin, 5 per cent, and lead, 30 per cent, which when properly made will run at a much higher temperature than 300 degrees Fahr. without changing and cracking. In fact it will run to nearly double that temperature. Another alloy that could be used for the entire casting and give better results than the one now used is copper, 70 per cent; lead, 20 per cent; tin, 5 per cent, and zinc, 5 per cent.

Cores Cause Trouble

We are making aluminum alloy pistons and would like to know how to keep bubble holes out of the castings. We make some with core hanging and some by setting the core. When the core hangs we get small pits around the skirt of the piston, and when the core is set we get bubble holes in the head of piston. These holes do not show until after the castings are machined. We use No. 12 aluminum alloy, and have a gate about 12 inches higher than the casting to get pressure. The metal is poured at a cherry red heat, or a little cooler.

From the description of the trouble it looks as though the cores were at fault. The aluminum fails to lie quietly against them, which of course would be due to gases evolved from the surface of the cores as they burn. Instead of these gases going into the structure of the core to reach exits, they are blocked there and must enter the metal in the endeavor to pass through it, but as the metal gets viscid through loss of heat, the gases are trapped. Our suggestion is to experiment with the cores first; make them as porous in structure as possible by using sharp sand and by providing for escape of gases.

If the castings can be poured cooler than a cherry red, by all means do this; and should many such castings be made it will be advisable to have a pyrometer, so each heat can be poured at a standardized temperature. Strike this pouring temperature first by direct experiment; as it will pay to follow such procedure remembering that with experimental work it will never do to trust to anyone's memory. Every little move must be put in writing right away and a record made for future reference. The straight No. 12 aluminum alloy with 8 per cent copper is not a suitable alloy for such castings as pistons. Usually such castings are made from alloys containing 12 or more per cent of copper, with, or without other metals.

British Association Celebrates 25 Years of Progress

By Vincent Delport
European Manager, The Foundry

THE Institute of British Foundrymen celebrated its twenty-fifth anniversary in the annual convention held at Leicester, June 12-15. The meeting was attended by over 300 delegates. The important part that the institution has played in the interests of the foundry industry during a quarter of a century, and the position of prestige that it has acquired among kindred technical associations in Great Britain and other countries were emphasized by S. H. Russell in his presidential speech.

On Tuesday, June 12, the Mayor and Mayoress of Leicester held a reception for members and visitors at the De Monfort Hall. The conference opened on the following morning, when the Mayor officially welcomed the delegates. In presenting the annual report, J. T. Goodwin, in charge of the foundries of the Sheepbridge Coal & Iron Co., Ltd., expressed gratification over the fact that a record number of new members had been enrolled during the year. The total number of members on April 30, 1928 was 1729, as compared with 1636 a year ago. The election of officers then took place. S. H. Russell, S. Russell & Sons, Leicester, was elected president for the year 1928-29. Wesley Lambert, chief of the metallurgical research department. J. Stone & Co., Deptford, London, was elected senior vice president. Mr. Lambert, now being president-elect will preside over the institution at the Third International Foundry congress to be held in London in 1929. F. P. Wilson, foundry manager, Pease & Partners, Middlesbrough, and president of the Middlesbrough branch, the junior branch of the institute was elected junior vice president.

After filling five vacancies on the general council, the award of the Oliver Stubbs medal was announced, the recipient being J. W. Donaldson, of the Scottish branch, for numerous papers contributed on cast iron. The president then announced that an anonymous donor had devoted a fund of £125 to be used for awarding annually a series of medals to each junior branch. The medals will be known as the Buchanan medals, to commemorate the memory of R. Buchanan who died in 1924. Messages of welcome from the foundry associations of America, France, Belgium and Germany were read.

The retiring president then inducted Mr. Russell into the chair and handed over to him the chain of office. Mr. Russell delivered his presidential address, which was a comprehensive review of the past work and future problems of the institute. The annual banquet was held at the Oriental hall, Wednesday, June 13.

S. H. RUSSELL

S. H. RUSSELL, elected president of the Institute of British Foundrymen, was born Aug. 20, 1886. He was educated at the Wyggeston grammar school and also devoted one year to a metallurgical course of Birmingham university under Prof. T. Turner. Mr. Russell entered his father's works as an ordinary apprentice at 16 years of age and worked four years as a coremaker and molder and then spent one year at Birmingham university. In 1910 he took over the supervision of the foundry under his uncle, who died in 1916, and since 1916 he has been a partner in the firm founded by his grandfather in 1864. He personally supervises all the foundry work. Mr. Russell has served on the council of the British Cast Iron Research association since 1923. He also is a member of the research and publication committees. He was president of the East Midlands branch of the Institute of British Foundrymen in 1923-24 and 1924-25.

The paper presented at the first technical session on Wednesday morning, June 13, was entitled "Malleable Castings," by W. T. Evans and A. E. Peace, Ley's Malleable Castings Co., Ltd., Derby. Although the company, with which the authors are associated, is engaged in the production of black heart malleable iron the authors endeavored to give an idea of the general production of both black heart and white heart malleable iron. In the discussion Mr. Murray, referring particularly to black heart iron, stated that the essential point is not so much the composition of the original iron, but the conditions under which the annealing is effected. He said that the production of malleable iron should be controlled to some extent by the microscope. Good pig iron can give bad castings if the heat treatment has been defective.

E. Longden, Manchester, said that the best malleable iron should be produced from a good original pig iron smelted from an ideal natural ore. J. G. Pearce, director, the British Cast Iron Research association, said that the paper should be considered the standard paper on the subject of malleable, although the authors have shown a slight preference for black heart iron. J. Shaw, Southsea, returning from a visit to America, referred to the use in that country of air furnaces for the manufacture of gray iron castings.

The first paper at the session on Thursday morning, June 14, was the French exchange paper presented on behalf of the Association Technique de Fonderie de Paris. The subject was "Study of Shrinkage in an Iron Casting," by Maurice Servais, of the Ecole Superieure de Fonderie, Paris. As this paper had not been in the hands of the members for a sufficiently long time, it was decided to conduct the discussion in writing. The American exchange paper on "Steel Castings for Severe Service" was pre-

sented on behalf of the American Foundrymen's association by John Howe Hall. Sir Robert Hadfield, honorary member of the Institute sent a written contribution to the discussion, which was read by V. C. Faulkner. Sir Robert said that manganese steel practice, including its heat treatment, is the same today as it was when he invented the alloy in 1882. With regard to the work-hardening properties, these have already been described by Osmond in France 25 years ago. The mechanical tests done with a view to ascertaining the physical properties of the metal were performed at the time by Sir Archibald Kennedy. Referring to steels containing from 1 to 2 per cent manganese, Sir Robert made such steels in 1894, and they were commercially developed in 1904. Mr. Faulkner added that these steels are popular in France.

Referring to the heat treatment of steel castings, Sir Robert stated that he has treated alloy steels for many years. The Usines des Terres-Noires, in France, also heat treated these steels. There were photographs of an ammunition chute and a gun shield, cast in steel in the Hadfield works, the shield weighing about ten tons. These castings were made in 1905 and 1908 and passed the most severe tests at the admiralty for whom they were made. With regard to heat resisting castings, these are being turned out at the Hadfield works up to a weight of 3 tons.

The exchange paper of the Association Technique de Belgique was written by Ivan Lamoureux, vice president of the association, on the subject "The Cohesibility of Rammed Sand," and presented by Mr. Faulkner. In the discussion, S. H. Russell, referred to a statement by the author implying that dry sand molds are sounder than green sand molds. He said that apart from the author's ideas on the position of the sand grains there are many reasons why dry sand is advisable. In his paper, Mr. Lamoureux states that in America when making cylindrical castings in loam molding, a portion of the pattern is fixed to the spindle arm, against which the sand is rammed. Mr. Russell said that in this respect, he believes that American sand is essentially different from British or Belgian sand and that a bond has to be introduced. Referring to the author's preference for cylindrical runners, Mr. Russell said that in his works, 75 per cent of the runners are square.

Mr. Cooper said that numerous failures have been caused, not by the sand, but by a defective method of preparing the sand. E. Longden stated that there are many reasons why the flat surfaces of a mold should be rough, among others, the rising of the metal and the heat of the metal causing expansion of the grains. He said that there are some sands in Britain equal to any continental sands and also emphasized the importance of preparation. J. T. Goodwin said that the grain of the timber used for the pattern has an influence on the surface of the mold. He emphasized the fact that the supply of good sand is not running short in England. He prefers round runners, because they eliminate corners and they are easier to draw. Mr. Poole stated that the suppliers should pay more attention to the grading of sands at the pits. He laid stress on the necessity of taking regular an-

Officers Elected

President

S. H. RUSSELL
S. Russell & Sons, engineers and founders, Leicester

Senior Vice President

WESLEY LAMBERT
Chief metallurgist, J. Stone & Co., Ltd., Deptford, London

Junior Vice President

E. P. WILSON
Foundry manager, Pease and Partners, Ltd., Middlesbrough

Elected to the General Council

A. R. Bartlett, London Branch
Professor Campion, Scottish Branch
J. R. Hyde, Sheffield Branch
H. Pemberton, East Midlands Branch

WESLEY LAMBERT

WESLEY LAMBERT, who has been elected senior vice president of the Institute of British Foundrymen, has been manager of the metallurgical department, J. Stone & Co., Ltd., Deptford and Charlton, London, since 1912. During his association with that company, Mr. Lambert has gained a world-wide reputation as a nonferrous metal expert. He was educated at Roan school, Greenwich, and at King's college, London. In 1890, Mr. Lambert was appointed assistant metallurgist at the Royal gun factory, Woolwich, and in 1894 he was metallurgist and lecturer on engineering chemistry at the Ottoman Naval arsenal. He was decorated with the order of the Medjidieh by the Sultan for services rendered, including the inspection of coal deposits at Heraclia. In 1901, Mr. Lambert took up the post of chief metallurgist at the Royal gun factory, Woolwich, and he later received a treasury award for special services. At one time he was special lecturer at the Sir John Cass Technical institute, London university, and he has read papers befor the Technical society. Mr. Lambert is a past president of the London branch of the Institute of British Foundrymen, and is now senior vice president of that institution. He is a member of the committees and panels of the British Engineering Standards association, and a Fellow of the Chemical society. He is a member of the Institute of Civil Engineers, of the Institute of Naval Architects, of the Institute of Marine Engineers, of the Institute of Metals, of the American Society for Testing Materials, etc. He also is a member of the International Committee of Foundry associations.

FREDERICK P. WILSON

FREDERICK PORTWAY WILSON, the new junior vice president of the Institute of British Foundrymen, was born at Middlesbrough, England, in 1869. He was educated at Middlesbrough high school and Giggleswick grammar school, afterward serving an engineering apprenticeship at Tees-side Engine Works and R. Stephenson & Co., Ltd., Newcastle. In 1892 he joined Wilsons, Pease & Co., Ltd., and eventually became assistant blast furnace manager. He was associated with the late Charles Wood in the development of slag-wool manufacture, both from the blast furnace direct and from cupola-melted slag. Later he became foundry manager in the firm, which then had been merged in Pease & Partners Ltd., producing railway chairs, brakeshoes, and other production work, together with general jobbing castings, ingot molds, etc. Mr. Wilson is a member of the Middlesbrough education committee, the councils of the Cleveland Institution of Engineers, the Constantine Technical college, the Cleveland Scientific and Technical institution, the Middlesbrough chamber of commerce, etc.

alysis of the argilaceous matter. In replying, Mr. Faulkner commended Mr. Lamoureux's paper and stated that its main object was to impress the necessity of avoiding the mending of molds at all costs.

In conjunction with the foregoing papers, a nonferrous session was held under the chairmanship of Wesley Lambert. A paper presented by George Mortimer, Wm. Mills & Co., Ltd., Birmingham, was entitled "Aluminum Castings Alloys," gave rise to an interesting discussion. Answering a number of questions, the author said that it is dangerous to heat aluminum above 740 degrees Cent. because the metal then absorbs gases and the result is brittleness and lack of elongation. Furthermore if the temperature is raised and the metal is left to cool down, larger grains are obtained. On the other hand, if the metal is heated to 900 degrees, in accordance with certain practices to chase gases, the metal should be remelted after solidification. The best method to cool down the bath when it has been overheated is to insert a mass of cold metal into the bath.

With reference to the nitrogen treatment, the author said that the nitrogen may be obtained commercially in bottles, but he has given up this method owing to anomalous results. He now uses the pre-solidification method. The author emphasized the point that there should be a great market for a cast iron pot that will not scale or flow in the aluminum bath. He concurred with Mr. Lambert that there are too many special aluminum alloys specified by engineers and said that the alloys listed in the British Engineers Standard association list are sufficient to cover all requirements.

The last paper on the program was entitled "Iron Foundry Costing," by W. R. Wintle, Sheepbridge Coal & Iron Co., Ltd. The author describes the method that he has installed in the foundries of his company. In opening the discussion, Mr. Russell laid stress on the fact that a foundry accountant must have works experience. He said that the principles laid down by Mr. Wintle should be applied, even to small foundries, where they can be adapted to the particular circumstances and simplified. W. B. Lake, of Braintree, suggested that, particularly in steel foundries, the overhead could approximately be apportioned in a greater proportion on the metal, in preference to putting it on the molders and coremakers. Mr. Harley said that where the metal is expensive, and when there are heavy gates and runners, these should be charged to the job. V. C. Faulkner asked if there is any justification in companies accepting large orders at an unremunerative price to reduce overhead expenses. In replying, Mr. Wintle said that the price of a casting to the works should be the market value. Answering to Mr. Lake he stated that the general expenses of management should not be charged too much on the cupola. He stated that heavy gates and runners of expensive metals in some cases may be charged to the job. Some foundries keep a wasters account and spread it over all the jobs, although the author does not recommend this procedure. He does not agree with the policy of taking large orders at an unremunerative price although this is done by certain firms.

Works visits were organized during the convention, to the Stanton Ironworks Co., Ltd.; the British Thomsom Houston Co., Ltd.; Wadkin & Co., Ltd.; Ley's Malleable Castings Co., Ltd,; the chief mechanical engineer's department of the London, Midland & Scottish Railway Co., Rolls-Royce Ltd. at Derby, Herbert Morris, Ltd,; John Taylor & Co.; and the Loughborough Technical college.

Mixing Ladle Preferred in Certain Cases

Question: Our castings vary in weight from a few pounds up to 4000. Would you advise the use of a mixing ladle in front of the cupola spout.

Answer: Like many other features in foundry practice the mixing ladle has its supporters and opponents. However, the opponents are not active opponents. They are willing to admit that the mixing ladle or its equivalent the forehearth has many meritorious points, but since they can get along as well without it why should they burden themselves with this extra equipment. This is particularly true in stove and other light work shops where the iron is *caught* direct from the spout in hand ladles to insure the highest temperature. Pouring iron from one ladle to another invariably lowers the temperature from 100 to 200 degrees. In foundries where heavy castings are made several taps are required to fill each ladle and in that manner the pouring ladle automatically becomes a mixing ladle.

British and continental European foundrymen favor a forehearth which is a covered chamber in front of the cupola and with the bottom on a lower level than the bottom of the cupola. The molten iron trickles steadily into this chamber which thus serves as a reservoir from which it is tapped as required. Friends of the process claim many advantages including a homogeneous mixture, conservation of heat, more even melting conditions in cupola through absence of fluctation in the amount of iron in the well. American foundrymen almost without exception regard the forehearth as a cumbersome and unnecessary adjunct to the cupola.

Mixing ladles are employed extensively, particularly in shops where the iron is poured from comparatively small ladles, that is ladles none of which are large enough to take a full tap from the cupola. They also are employed in many foundries where the stream runs continuously from the spout or almost continuously for the entire duration of the heat. The pouring ladles either supported on trucks or suspended from monorail hoists, are filled in rotation from the mixing ladle. Local conditions usually decide whether a mixing ladle is or is not required. For example, in a small foundry or in a larger foundry where a considerable amount of iron is poured from the ordinary double shank and where the iron is carried by hand from the cupola, a mixing ladle is an absolute necessity. To maintain uniform melting conditions the cupola should be tapped after each charge has melted and the mixing ladle should have sufficient capacity to hold this amount with a little to spare. If the small ladles are filled at a distance from the cupola the ladle into which the metal is tapped from the cupola serves as a mixing ladle or perhaps one of several that pass before the cupola in regular rotation. Boiled down to a final word it may be said that where more than one tap is required to fill a ladle no mixer is needed, and where one tap will fill more than one ladle a mixer is advisable.

To Make a Survey

Preparatory to calling a conference of the standing committee on simplified practice recommendation No. 48, shovels, spades and scoops, to consider the revision or reaffirmation of this recommendation, the division of simplified practice of the bureau of standards, has been requested by the chairman of the committee to initiate a survey among acceptors of the simplification to ascertain the extent to which the present standard has proved practicable and whether further eliminations can be advantageously effected.

Cleaning Room Progress Aids Production of Quality Castings

By Frank G. Steinebach

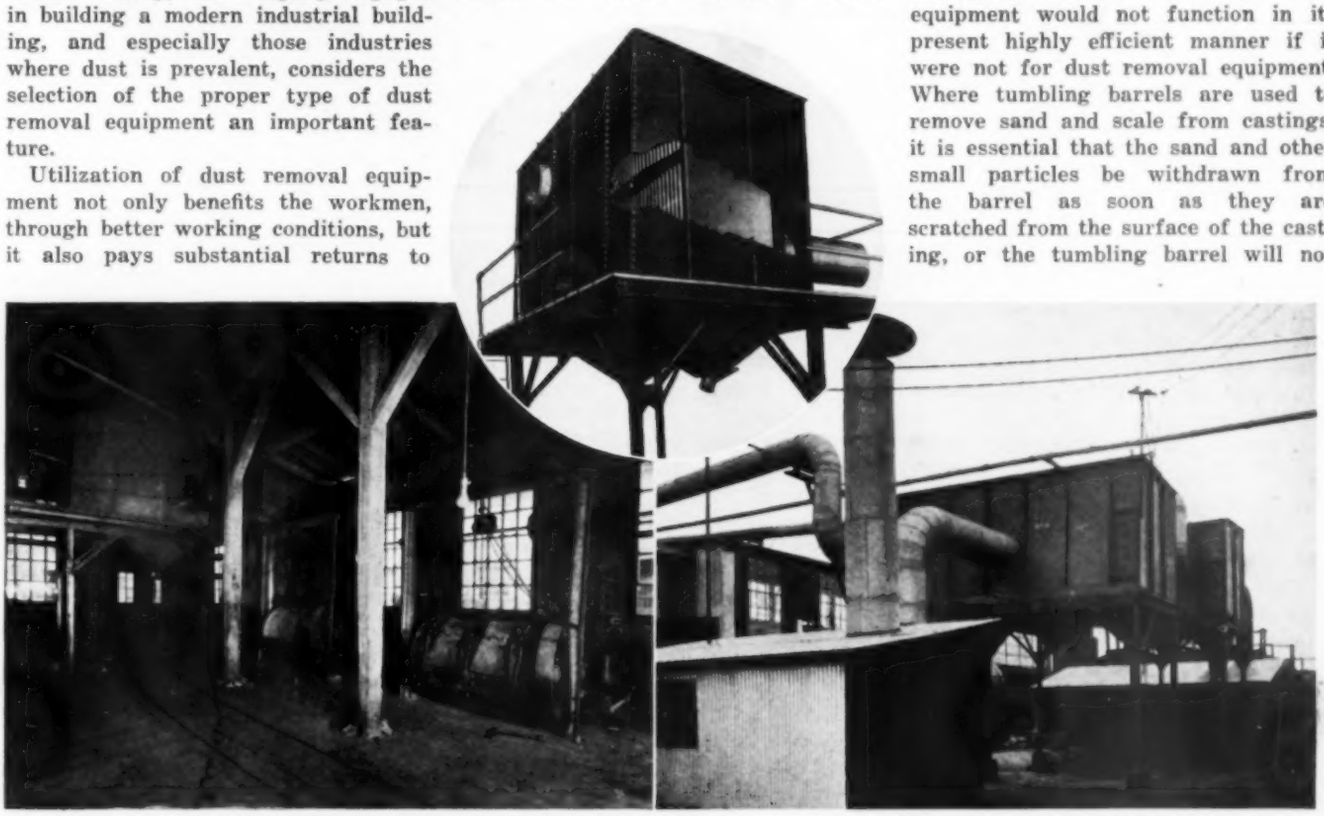
Part IX

CONSIDERED only from the humanitarian standpoint, the development and perfection of equipment for removing dust from the air in buildings has been one of the greatest aids in securing health and happiness for industrial workers. No more is it necessary for workmen to labor in a dust-filled atmosphere, breathing fine particles of various substances, which sooner or later may result in serious impairment of the health. Today, the company engaged in building a modern industrial building, and especially those industries where dust is prevalent, considers the selection of the proper type of dust removal equipment an important feature.

Utilization of dust removal equipment not only benefits the workmen, through better working conditions, but it also pays substantial returns to the company investing in the dust-removal installation. With working conditions improved, the workman finds it possible to speed up his work without a great amount of increased effort. Labor turnover is reduced greatly and in many instances the time lost through sickness is decreased. Removal of dust also reduces excessive wear on the plant machinery and, where the dust is of an inflammable character, prevents serious accidents from explosion.

In numerous instances an investigation has shown that the material collected from the atmosphere is of value as a by-product. For example foundry dusts are being used in brick yards as a parting for clay molds. Silica dust collected in the arresters in brass foundries is mixed with core sand to produce an open core which may be knocked out more readily. Considerable cement is recovered daily by dust collecting equipment in the average cement plant. It is interesting to note in passing that cement producing companies are large users of dust collecting equipment.

Modern foundry cleaning room equipment would not function in its present highly efficient manner if it were not for dust removal equipment. Where tumbling barrels are used to remove sand and scale from castings, it is essential that the sand and other small particles be withdrawn from the barrel as soon as they are scratched from the surface of the casting, or the tumbling barrel will not



FIGS. 78-79—THE DUST ARRESTER EQUIPMENT MAY BE BUILT NEAR THE TUMBLING MILLS, SANDBLAST OR OTHER EQUIPMENT, OR IT MAY BE PLACED ON PLATFORMS OUTSIDE OF THE BUILDING. FIG. 80 (TOP)—THE CASING IS SEPARATED INTO TWO COMPARTMENTS BY THE ROW OF FILTER FRAMES COVERED WITH CLOTH

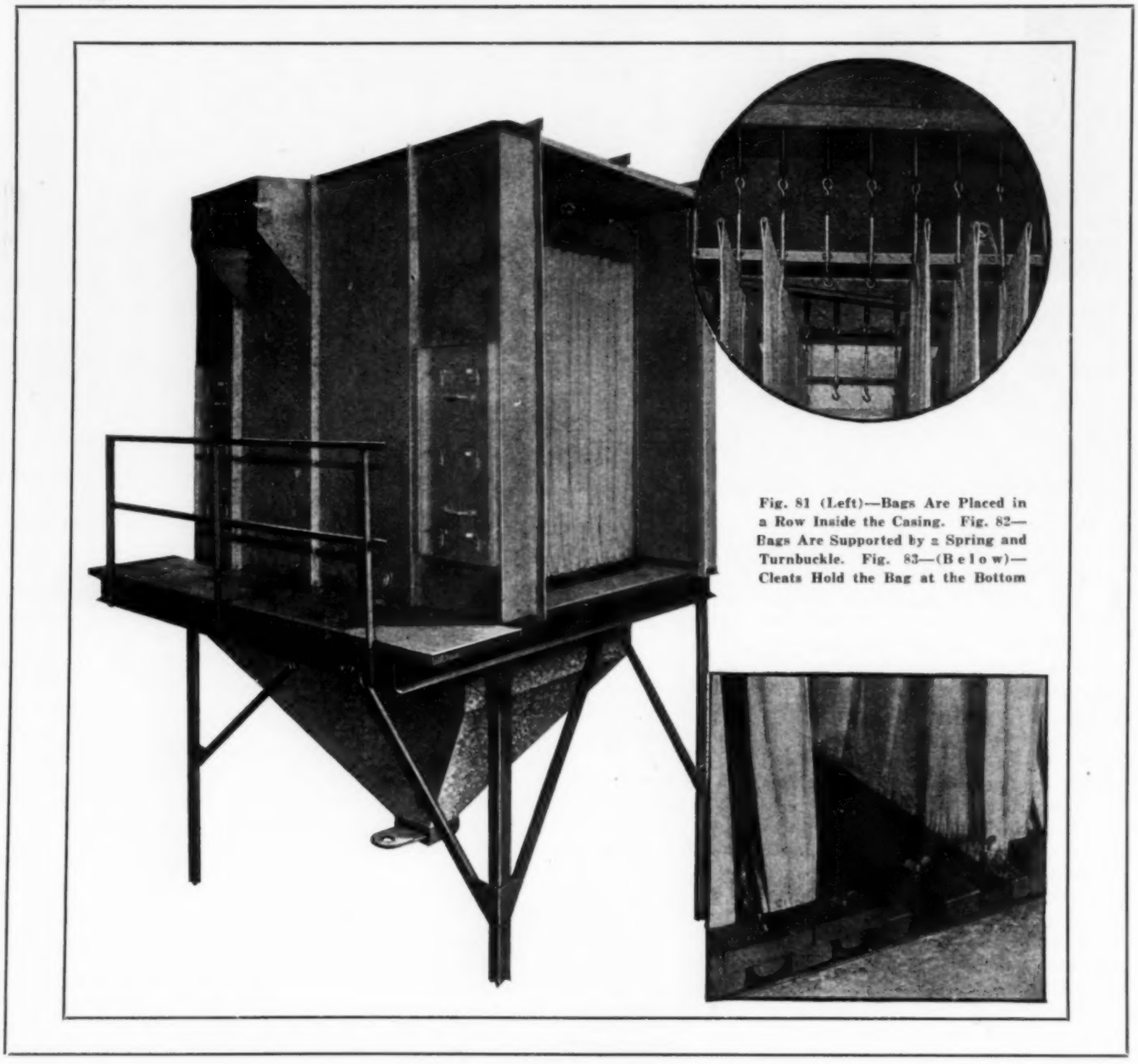


Fig. 81 (Left)—Bags Are Placed in a Row Inside the Casing. Fig. 82—Bags Are Supported by a Spring and Turnbuckle. Fig. 83—(Below)—Cleats Hold the Bag at the Bottom

clean the castings properly. Without the dust removal equipment, it would be almost impossible to operate the various types of sandblast equipment, which previously have been described in this series of articles. Recently, equipment has been perfected to remove and collect the dust produced by grinding operations.

Early attempts toward removal of dust resulted in equipment which carried the dust laden atmosphere outside the plant and discharged it, permitting the dust to settle over the surrounding territory. However, the damage to the plant and other property was too great and methods for collecting the dust were developed. Today, two general types of dust collecting and conveying equipment are in use in the foundry cleaning room. One type of unit consists of a suction fan which draws the dust laden air from the room, the tumbling barrel, the sandblast compartment, or other point of origin. This fan sucks the air into a filter compartment, where the dust and dirt are removed. If desired the cleaned air may be returned to the room. In the second type of equipment, the dust and dirt are carried into a cyclone type dust collector where the dust is removed and the air is delivered to the outside atmosphere. When the dust and dirt carried in the system are of an abrasive nature, it is best to place the fan beyond the separator to avoid wear on the fan.

The filter type equipment, commonly called a dust arrester, has been allied closely with sandblast equipment, and is used extensively in the foundry cleaning room. Many of the manufacturers of sandblast equipment also produce arrester equipment, and in numerous cases, sandblast equipment is designed and built with the arrester equipment an integral part of the unit. A certain amount of similarity exists in many points of design and methods of operation in the dust arrester equipment built by the various manufacturers.

Usually the filtering element consists of a bank and cloth screens or a group of cloth bags. Recently a cellulose material has been placed on the market for the purpose. The filtering elements are in a steel case and so arranged that a dust compartment is located on one side and a clean air compartment is found on the opposite side. Air, with the dust and dirt in suspension, is sucked in at one side by the fan. As the air passes through the filtering element, the particles of dust are removed by the fine threads or nap on the cloth and the

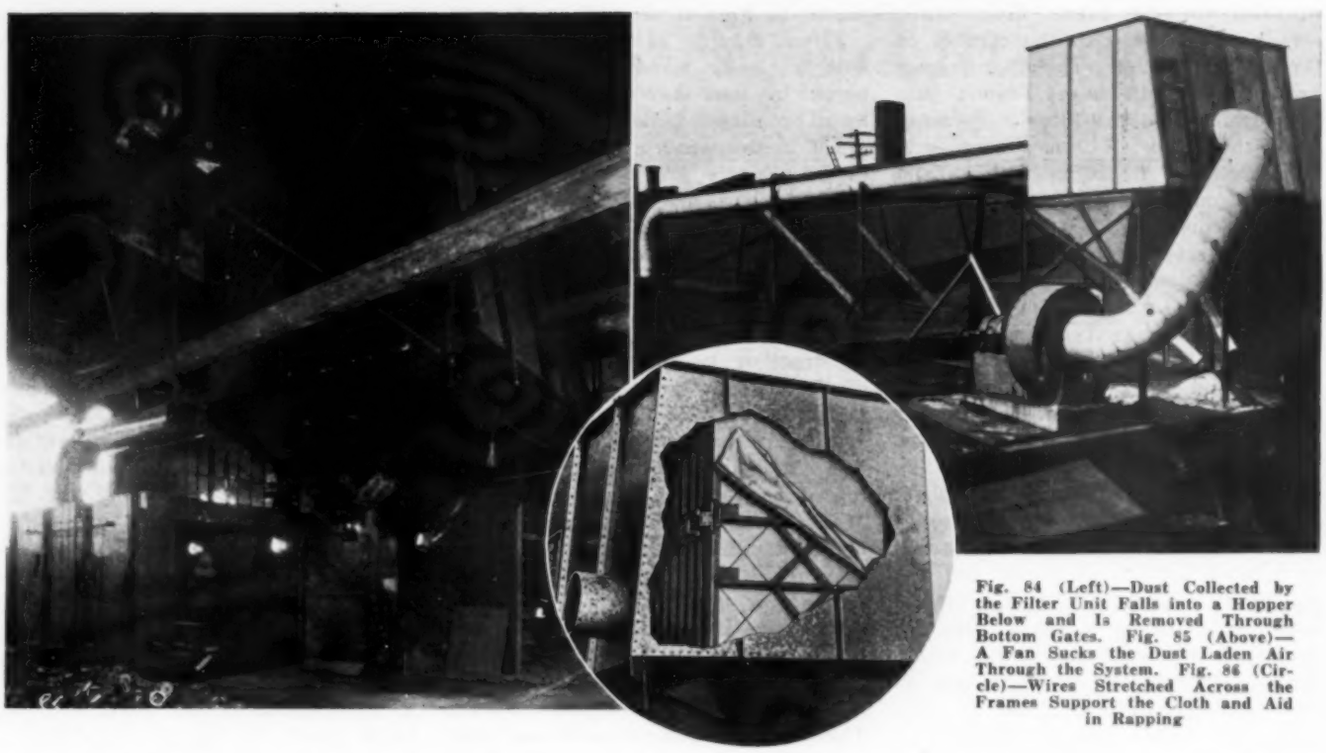


Fig. 84 (Left)—Dust Collected by the Filter Unit Falls into a Hopper Below and Is Removed Through Bottom Gates. Fig. 85 (Above)—A Fan Sucks the Dust Laden Air Through the System. Fig. 86 (Circle)—Wires Stretched Across the Frames Support the Cloth and Aid in Rapping

cleaned air is directed to the desired point.

Some means of rapping the screens is provided in each case. At certain intervals, the air entering the unit is directed to another unit or the ventilating fan is stopped, and the rapping device is operated. This causes the dust and dirt, which has collected on the filtering element, to fall to the bottom of the steel container, where it is collected in hoppers and removed. The removal of dust from the filtering material at the end of a certain predetermined interval is essential if the unit is to operate effectively to handle maximum volume.

Velocity of the air through the cloth is an important consideration. The velocity should be sufficiently low that the dust will not be carried into the meshes, but will form a loose, fluffy layer on the surface and will not obstruct the free passage of the air. It may be seen that a large filter area in proportion to the volume of air handled will cause the dust to lie on the filter in a loose manner and will lengthen the operating time between rappings.

Since there are numerous points of difference in the design of various builders, several types of dust arresters will be described in more or less detail. In one type of unit, consisting of a steel housing divided into two compartments by an assembly of wood frames covered with the fabric material, the air enters one compartment and is directed against a baffle which spreads the air throughout the entire compartment. To permit the removal of one frame without disturbing the remaining frames, each frame is mounted individually. The unit is designed with four filter frames to the foot. The frames are constructed to permit 1½-inch spaces between frames on the entry side and also 1½-inch openings on the discharge side.

A protection against wear has been

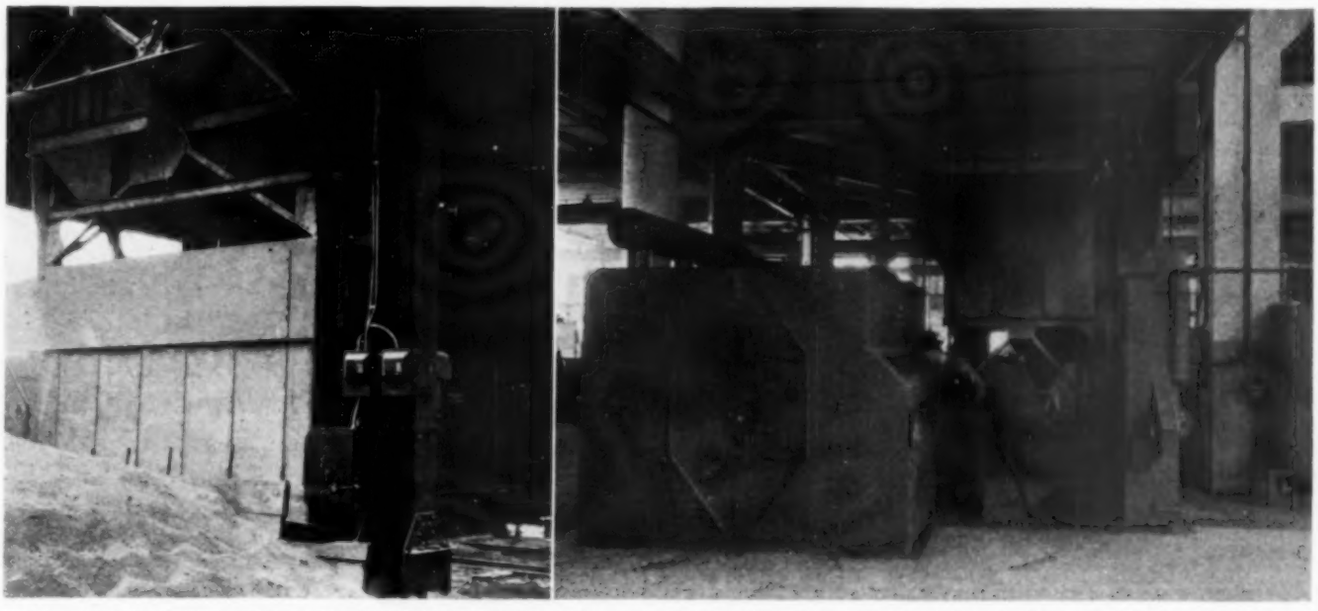


FIG. 87—AN ARRESTER UNIT BUILT IMMEDIATELY ABOVE A CAR TYPE SANDBLAST ROOM. FIG. 88—DUST ARRESTER EQUIPMENT IS AN ESSENTIAL PART OF THE MODERN SANDBLAST

provided for the fabric filter which comes in contact with the corners of the wooden frames. The filter frames are padded with heavy, round jute pads which hold the filter cloth away from the wood. A heavy cord in a slot seals the frame at the top and the bottom. The vibrator bar is bolted securely to each frame on the clean air side of the arrester. The vibrator is made of a steel casting bolted to the rapping bar, and having an integral stub shaft. A self aligning ball bearing race is clamped to the stub shaft and the outer race is clamped to a rotating housing which is provided with an eccentric weight located immediately above the center of the ball bearing. A shaft extending from the housing is coupled to a motor. The vibrator housing is rotated at a high speed and the eccentric weight provides a radial load or vibration against the ball bearings, this vibration being transmitted through the steel casting to the rapping bar.

Another builder makes arresters in three sizes, the heights being 9 feet 10⅝ inches, 6 feet 10⅝ inches and 5 feet 4⅝ inches. The width in all cases is 7 feet 10 inches and the length varies from 3 feet up, depending upon the volume of air to be handled. The filter screens consist of cloth mounted on basswood frames. A different method is used to rap the filter frames than that previously described. A rapping shaft extends the entire length of the arrester unit and is driven by a direct connected motor or through a belt. This shaft carries a number of hammers, and as the shaft revolves, these hammers strike the screens, causing the dust accumulated on the screens to fall in the hoppers below. The rapper shaft with hammers is shown in Fig. 91 at bottom of page.

Filter frames of cypress covered with a closely woven cloth and supported by steel stay wires, is featured by a prominent builder. The cloth is glued to the wooden frame and binding strips are provided at the open side. Screens are supported on one side by metal clips screwed to and extending beyond the frame. These clips fit into holes in an angle iron supporting bar. The other side of the screen rests in the screen crib. This construction permits free movement of the screens when they are being vibrated. The entire group of screens is rapped at one time through a shaking rod and an anvil plate on the top of each screen.

That company also builds a line of small units designed for operations requiring from 700 to 2800 cubic feet of air per minute. In these arresters the air enters the casing near the bottom, travels up through the screens and leaves through openings in the top of the arrester housing. The unit is equipped with an anvil block built along the bottom of the screens through which they are vibrated. A hopper is provided below the casing to hold the dust from each bank of screens.

In another type of arrester, the dust-laden air enters a settling and expansion chamber at the bottom of the metal casing. Much of the larger material falls into the hoppers at the bottom as the speed is decreased, and the lighter particles pass upward and are caught by the cloth screen. The cleaned air is exhausted at a point near the top. The filter unit consists of a cloth stretched over a wooden frame. The frame has a number of copper covered wires so located that they lie against and vibrate in contact with the screen cloth, thus cleaning the meshes each time the rapper is operated. The unit may be equipped with an air operated vibrator located either inside or outside of the housing.

Other types of arrester units having a cloth mounted on a wooden frame for the filter unit, use various methods of rapping. One interesting type has a track extending the full length of the unit, and about a foot below the bottom of the screen frame. A special rapping device operates over this track. This device has a plunger which operates up and down at a rapid rate and strikes a plate on the bottom of each screen frame as the rapping device moves over the track from one end to the other.

Instead of the frame type filter which has been described, one manufacturer uses a flat, bag-type filter. The unit consists of a steel housing built over an inlet expansion chamber with hopper bottoms. The large chamber is separated from the expansion chamber by a steel partition having a number of openings to allow the air to pass from the expansion chamber to the upper chamber. These openings are covered with a series of bags which filter the air. The bags are supported on individual springs and are connected to a motor operated shaker.

The flat bags are seamed vertically every few inches to permit them to hold the flat shape under suction. The

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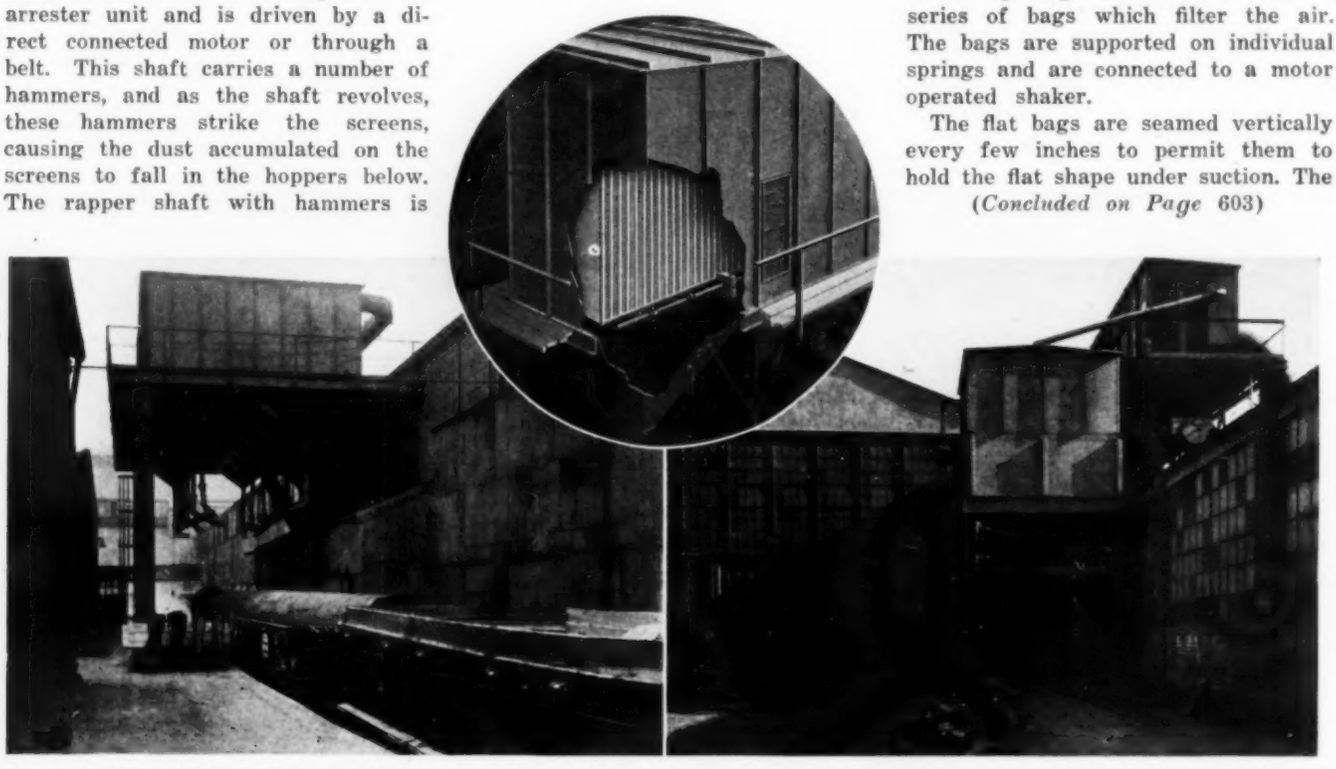


FIG. 89—DUST ARRESTER UNIT INSTALLED AT A LARGE STEEL FOUNDRY. FIG. 90—TWO DUST ARRESTERS CLEANING AIR AT A GRAY IRON PLANT. FIG. 91 (CIRCLE)—SECTION OF A DUST ARRESTER WITH CASING CUT AWAY TO SHOW ARRANGEMENT OF SCREENS AND THE RAPPING DEVICE

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Investigates Effect of Nickel

Nickel in Cast Iron, by Arthur B. Everest, *Foundry Trade Journal*, London, April 12, 1928.

This article is the first part of a paper describing the effect of nickel on cast iron. The author describes the various methods of adding nickel to cast iron including natural nickel bearing pig iron, synthetic nickel bearing pig iron, nickel steel scrap, pig or ingot nickel alloys, nickel pellets or shot. Tests were conducted on three types of cast iron used for engineering purposes and the amount of nickel added ranged around 1 and 2 per cent. The bars used for the tests were 1.2 inches in diameter and 21 inches long tested on 18-inch centers. On some tests of high grade automobile engine iron the author found that the drill hardness of the iron was progressively raised but all samples were readily machinable. Brinell hardness tests on step bars showed an increase in hardness and all sections tested showed a gray fracture. Microscopic examination showed first additions of nickel coarsened the graphite somewhat, but 2 per cent nickel gave a finer form of graphite. Etching showed pearlitic structure with even distributions of phosphide areas and manganese sulphide crystals.

Tests on a different grade of iron gave somewhat similar results. The author then turned to crucible melted iron as a preliminary to carry on larger scale operations in the cupola. This iron contained about 1 per cent silicon and normally when cast had a white to mottled fracture. Two per cent nickel added to this base gave a gray fracture except on thin sections. The structure was dense and fine. Brinell numbers were higher for the nickel bearing pieces, but these were machinable except in the thin sections of the test bar. The article contains numerous tables giving the analyses and results of physical tests, and a few illustrations show the appearance of the fractures.

Discusses High Quality Iron

The Manufacture of High-Duty Cast Irons, by F. Girardet. *Bulletin*, Association Technique de Fonderie de Paris, February, 1928.

In a high-duty cast iron the graphite should be obtained in small particles, sometimes of a nodular aspect, uniformly distributed in the metal and as little abundant as possible. The matrix surrounding the graphite should be in fine and regular grains. From a quantitative standpoint, the influence of graphite is of primary importance and much greater than that of the matrix. Consequently, the study of a high-resisting cast iron is mainly a question of graphite.

Various manners in which the graphite can be influenced then are given, both from the chemical and the physical standpoint, and the way in which the most satisfactory conditions are obtained follows. It is shown why, to obtain the iron in a homogeneous solution, it is necessary to heat it at a sufficiently high temperature and regulate the additions of scrap in accordance with the temperature of the cupola, so that all the scrap should be dissolved.

The author admits that heredity in cast iron exists, and in fact, suggests that favorable germs can be innoculated into the metal by the addition of small quantities of selected iron. He then gives the composition of certain cast irons that he uses, and shows the effect of the innoculation of selected irons on the final result. He lays emphasis on the necessity of micrographic examination of the iron used for obtaining the castings.

The second part of the article is devoted to the study of the equipment used for the manufacture of high tensile cast irons, and the author stresses the necessity of agitating the bath. He also insists that in cupola practice it is necessary not only to agitate the bath but to do so outside the cupola under atmospheric pressure, and that the fore-hearth or apparatus in which this operation is performed should be heated. After having pointed out the drawbacks of agitating by stirring, the author gives a description of a gyratory fore-hearth of his own invention.

Roll Making Requires Care

Chilled Iron Rolls, by Archibald Allison, *Foundry Trade Journal*, London, April 12, 1928.

In this article which is the first part of a paper on the subject, the author states that the data presented are the results of observations of over 300 casts made. The author believes that cupola iron is not suitable for high grade chilled rolls, and uses an oil fired furnace which easily melted 2800 pounds. Materials used were old rolls with additions of various types of English pig irons to give a suitable analysis in the molten product. Chill test bars were made and it was found that with low total carbon, that is under 3.2 per cent, that the roll would show less chill than the bar. This made it necessary to increase the chill on the bar to obtain the correct chill in the roll. The chill plates against which the bars were cast were heated to about 60 degrees Cent. to approximate roll pouring conditions. In casting the author found that the mold must be blacked evenly and thinly to prevent pinholes. Experiments were made on increasing the phosphorus, but the best results seemed to be obtained at 0.4 per cent phosphorus. The best pouring temperature was found to range between 1210 and 1260 degrees Cent. Below 1210 degrees Cent., the upper end of the barrel at right angles to the working surface where the neck is formed by the mold sand, was studded frequently with holes and pellets. With a temperature over 1260 degrees Cent. spongy necks and pinholes in the barrel likely were to occur.

Studies Corrosion Protection

A Contribution to the Study of Corrosion, by Jean Cournot. *Bulletin*, Association Technique de Fonderie de Paris, March, 1928.

In a brief theoretical discussion, dealing especially with methods of testing the various methods of protection, emphasis is laid on the extreme complexity of these testing methods and their measurement. Tests are effected to show the adherence of a protective coating, its permeability, its hardness, its resistance to wear. Micrographic tests also are used. The uncertain results of corrosion tests proper, owing to the number of variables, are emphasized.

The main portion of the article discusses the various means of combating corrosion. After having mentioned the treatment of the corrosive medium, the use of homogeneous metals and electro-chemical protection, the author develops in detail the various methods of surface protection. He first reviews the various ways of cleaning the surface, either mechanically or chemically, or by electrolytic methods. The latter method he particularly recommends, provided that the bath is not acid.

The various methods of protection then are discussed in detail: (1) by dipping the parts in molten metal; (2) by cementation, that is by penetration of a solid by one or several chemical elements in solid or liquid or gaseous form; (3) by spraying, particularly zinc spraying; (4) by casting together ingots of the primary metal and ingots of the protective metal, and rolling them; (5) by stamping two or three thin sheets of the protective metal against the primary metal, and rolling them together; (6) by electrolytic deposits, in which the author particularly emphasizes the deposit of cadmium, which, to date, appears to have given results more satisfactory than any other method. Chromium plating also is referred to, but great stress is laid on the necessity of perfectly conducting the operation, and the attendant difficulties; (7) protective coating by non-metallic materials, such as paints, varnishes, japanning; (8) the anodic process, consisting in placing the parts as anodes in a solution of sodium ferrite; (9) by electro-chemical displacement, which consists in placing the parts in a solution of a metallic salt without using any electric current; (10) various chemical processes other than those previously mentioned. In this section the author makes particular mention of, and explains, the method of parkerization.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ More Light on Coke

FOUNDRYMEN generally and more particularly those who operate cupolas will follow with interest the work of a joint committee made up of representatives from various associations which now is engaged in studying coke with a view of formulating a set of standard specifications through which the customer will receive material to meet his requirements, which will not impose an impossible burden on the producer and which can be quoted and applied intelligently by a non-interested third party in settling any dispute which may arise between dealer and consumer. Considerable work of a more or less spasmodic character has been carried on in this field since 1905 when the American Society for Testing Materials first appointed a committee to undertake the establishment of standard specifications for foundry coke.

CONFRONTED at the beginning with an apparently chaotic condition the committee labored steadily and gradually succeeded in bringing some sort of order out of confusion. It definitely established certain standards to govern methods of sampling, chemical analysis, physical tests and the behavior of coke under service conditions. First accepted tentatively, the various recommendations of the committee later have been adopted formally and incorporated in the standards of the association where they are available for the benefit and information of those interested.

ONE of the problems confronting the joint committee is the fact that great changes have taken place and still are in process in the coke making industry. Physical and in some instances chemical standards which once indicated that a coke was particularly well fitted for metallurgical purposes, no longer can be accepted as guides. For example, 72-hour beehive coke in large pieces and presenting a characteristic silvery fracture once was regarded as standard. The advent of by-product coke has upset all these ideas and other standards besides coking time and physical appearance are required to guide the purchaser and user. Activity of the committee now is directed toward correlating present chemical and physical tests with performance in the cupola with a view of issuing specifications for foundry coke.

¶ Why a Summer Slump?

ACCORDING to a profound statement just issued by the Cleveland chamber of commerce, the reason for exceptional prosperity now prevailing in the belt of states which includes New England, New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois and others extending to the West, lies with the climate. Perhaps this close proximity of the words *lies* and *climate* is unfortunate and unintentional. Perhaps, also this profoundly oracular message of the chamber of commerce, ascribing all industrial enterprise and comercial activity to the average mean temperature of 65 degrees characteristic of this pet territory, may be only another hot weather manifestation, a dog-day theory.

EARLY writers on conditions in the southern colonies, where fortunes were based on tobacco, sugar and in later years, cotton, held a different theory on the effect of climate on human activity. They stated that the imported African slaves performed four times as much work as the native Indians whom they vainly had tried to impress as field hands. The discrepancy was explained ingeniously by the excuse that the Indians, with few exceptions, were long residents of the temperate zones, while the black slaves came from equatorial Africa and therefore were accustomed to extreme heat and hard work. Might not the fact that the proud Indians refused to work while the negroes with a heritage of slavery were afraid to rebel have been the real answer in this case?

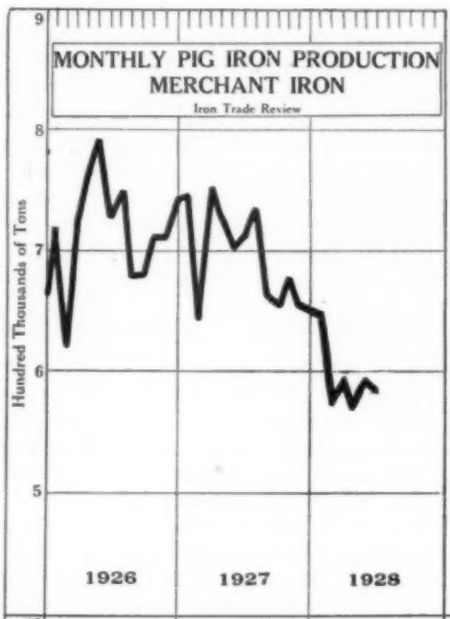
WHAT has all this to do with the foundry business? Merely this. Many people look for a summer slump. Vacation time—too hot—much golf and the gypsy trails which entice the motorist, all play a part in bringing about the usual summer recession. Incidentally, for those who choose to exert even normal effort, the summer slump never seems to come to pass.

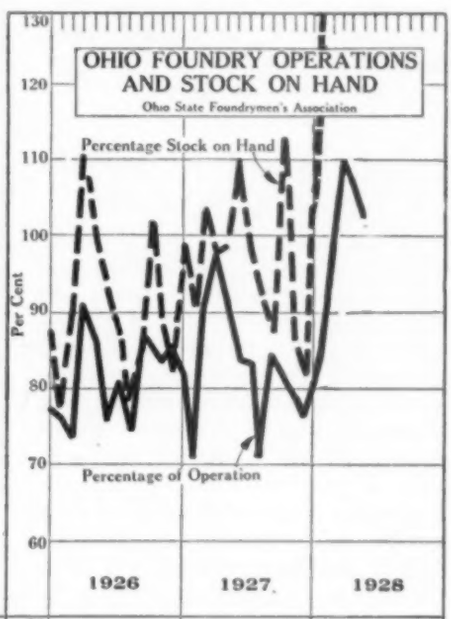
Trade Trends in Tabloid

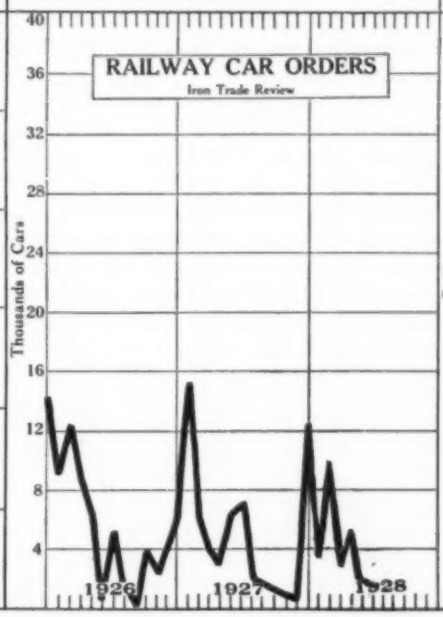
FOUNDRY operations, particularly in jobbing lines, are spotty. Some castings manufacturers are working full time, with orders ahead for six weeks or more, while others are dropping to three or four days a week. Car orders stepped up slightly in May, but again have receded. The greatest volume of construction work ever under way in the United States in a single month according to the Associated General Contractors of America was reported for June, which registered 32 per cent ahead of May. Implement business is active, with increasing export demand. Steel foundry operations are slowly increasing. Pig iron production during June showed a slight decline, according to statistics compiled by *Iron Trade Review*. The total output was 3,088,882 tons, compared with 3,292,790 tons for the previous months. On a daily average basis, June fell behind May by 3256 tons per day. The production of merchant iron in June totaled 584,218 tons, compared with 596,664 tons for the previous month. Average New York prices for nonferrous metals during June, according to the *Daily Metal Trade*, follow: Casting copper, 14.491c; electrolytic copper, 14.75c; Straits tin, 47.938c; lead, 8.242c; antimony, 9.845c; aluminum, 23.90. Zinc averaged 6.159c, E. St. Louis, Ill. In general jobbing nonferrous lines, the demand for plumbing goods sustains a good operating rate.

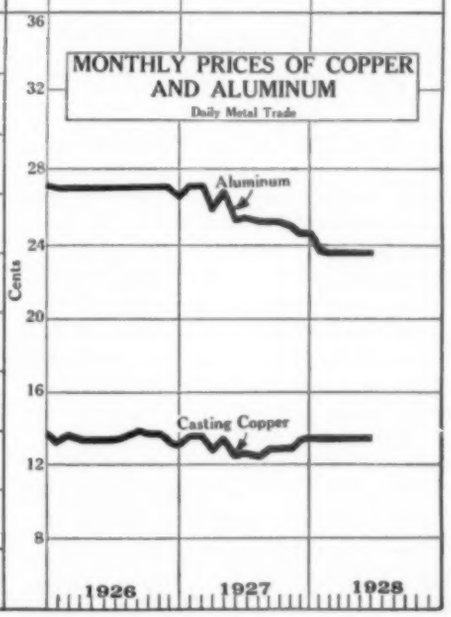
RAW MATERIAL PRICES
July 7, 1928

Iron	
No. 2 foundry, Valley	$16.50 to 16.75
No. 2 southern, Birmingham	15.50
No. 2 foundry, Chicago	18.00
No. 2 foundry, Philadelphia	20.26 to 20.76
No. 2 foundry, Buffalo	17.00
Basic, Valley	15.75 to 16.00
Basic, Buffalo	17.00
Malleable, Chicago	18.00
Malleable, Buffalo	17.50
Coke	
Connellsville foundry coke	$3.50 to 4.50
Wise county foundry coke	5.00 to 5.50
Scrap	
Heavy melting steel, Valley	$14.25 to 14.75
Heavy melting steel, Pitts	13.75 to 14.00
Heavy melting steel, Chicago	12.50 to 13.00
Stove plate, Buffalo	13.00 to 13.50
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	14.25 to 14.75
No. 1 cast, Philadelphia	16.00
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Birmingham	14.00 to 14.50
Car wheels, iron, Pittsburgh	14.00 to 14.50
Cars wheels, iron, Chicago	13.00 to 13.50
Railroad malleable, Chicago	12.50 to 13.00
Agricultural Mal., Chicago	11.75 to 12.25
Malleable, Buffalo	15.00 to 15.50
Railroad malleable, Pitts	13.75 to 14.00
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	14.50
Electro copper, producers	14.75
Straits tin	46.12½
Lead, New York	6.30
Antimony, New York	9.37½
Nickel, electro	37.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.50 to 17.00
Zinc, East St. Louis, Ill	6.20









Personal

Henry Banke has been made core room foreman of the Molloch Co., Kaukauna, Wis.

Thomas J. O'Brien, affiliated with the Fort Pitt Malleable Iron Co., Pittsburgh, for more than a quarter of a century, and recently secretary and director of purchases, has resigned.

Leon Thomas, president of the Association Technique de Fonderie de Paris, has been honored by the King of Belgium, who has conferred upon him the order of Leopold of Belgique.

Boyd Emerick, formerly assistant foundry superintendent of the Corry, Pa., plant of the United States Radiator Corp., has been made superintendent of the plant, succeeding Clyde E. Weir, who was transferred to the Dunkirk, N. Y., plant. For the past three years, Mr. Emerick has been at Geneva, N. Y., as foundry superintendent of the Radiator corporation plant there.

Hoist Builder Elects New Officers

The Chisholm-Moore Hoist Corp., division of Columbus McKinnon Chain Co., Cleveland, recently elected the following officers: Julius F. Stone, president, Julius F. Stone, Jr., vice president, J. C. Dunn, vice president and treasurer and Frederick Mitchell, secretary. Directors elected are as follows: Julius F. Stone, Julius F. Stone, Jr., J. C. Dunn, A. L. McKinnon and Frederick Mitchell. John R. Mears will continue as sales manager of the new corporation.

Oakland Announces Plans for Large Foundry

The Oakland Motor Car Co., Pontiac, Mich., has started the construction of a new gray iron foundry which will represent an investment of several million dollars. Six new buildings will comprise the foundry unit including the main foundry building, a core building, a cupola building, a sand storage building, a cleaning building and a service building. The group will have a total of 200,000 square feet of floor space and the foundry will have a pouring capacity of 450 tons of castings daily. Full operations are expected to be reached not later than February, 1929.

The main foundry building will be 260 x 248½ feet with a height equivalent to two stories. The core building will be one story high, 160 feet wide and 247½ feet long. The sand storage will be 50 feet high, 80 feet wide and 225 feet long. The cupola building will be 60 x 100 feet and three stories high, the cleaning room building 120 x 260 feet and one story high, and the service building 60 x 260 feet and two stories high.

Made General Manager of Equipment Firm

John S. Sammons recently was appointed general manager of the American Foundry Equipment Co., Mishawaka, Ind. Mr. Sammons was born in London, Ont., April 17, 1890, and received his grammar school education in the public schools of Rockford, Ill. At the age of 14 he began his industrial career as a drill press operator for the Andrews Iron & Wire Works, Rockford.

JOHN S. SAMMONS

For the past 15 years Mr. Sammons has been connected with several important companies in sales and executive capacity. For the past two and one-half years he was sales manager for the Beardsley & Piper Co., Chicago. During that time he visited over 300 foundries, securing first-hand information on the problems and requirements of the industry.

Equipment Firm To Build New Plant

The Titgen-Eastwood Co., Luzerne and D streets, Philadelphia, which purchased the drawings, patterns and eqquipment of the J. W. Paxson Co., Philadelphia, about a year ago, has dissolved partnership and has been incorporated under the laws of the state of Pennsylvania. The company has purchased a two acre plot of ground and will build a new boiler shop, machine shop, pattern shop and forge shop. It is expected that the new plant will be completed in 90 days. Officers of the new corporation are as follows: Harry W. Titgen, president; Abraham B. Eastwood, vice president and secretary; Christian Gunther Jr., treasurer; and William Dunbar, general superintendent of plant.

Sells Sand Equipment

The Royer Foundry & Machine Co., Wilkes-Barre, Pa., recently has sold sand separators and blenders to the American Valve Co., Coxsackie, N. Y.; De Laval Steam Turbine Co., Trenton, N. J.; H. P. Deuscher Co., Hamilton, O.; Gartland-Toledo Foundry Co., Toledo; E. F. Hamlin Brass Foundry Co., Rochester, N. H.; Hobart Bros. Co., Troy, O.; J. D. Johnson Co., Inc., Hainesport, N. J.; Kohler Co., Kohler, Wis.; National Cash Register Co., Dayton, O.; New England Butt Co., Providence, R. I.; New Foundry Appliance Co., Trenton, O.; Toledo Alloyed Castings Co., Toledo; Wright Aeronautical Corp., Paterson, N. J.

Equipment Orders Gain

The index of gross orders for foundhy equipment in May was 335.6 as compared with 107.7 in April, according to a report of the Foundry Equipment Manufacturers association. The index of shipments was 104.7 in May as compared with 112.5 in April. Unfilled orders gained heavily from 126.1 in April to 344.5 in May. The base is the average monthly shipments for the years 1922-23-24. Comparisons of monthly orders as presented by the association follow:

	1924	1925	1926	1927	1928
Jan.	141.8	104.2	168.2	180.4	132.7
Feb.	121.0	108.8	154.9	198.0	123.6
March	121.9	159.3	157.3	131.1	138.6
April	146.8	124.3	113.2	130.0	107.7
May	108.0	113.3	128.5	134.8	335.6
June	96.4	110.5	133.5	138.4	.....
July	62.8	117.0	127.3	89.9	.....
Aug.	77.5	190.0	141.2	106.4	.....
Sept.	66.0	94.2	114.0	80.4	.....
Oct.	85.5	149.5	140.5	98.0	.....
Nov.	91.4	180.3	133.4	95.8	.....
Dec.	137.8	140.1	181.0	106.8	.....

Andre Citroen, one of the most progressive of French industrialists, points out that where 800,000 workmen are necessary to produce 4,000,000 cars in the United States, 400,000 workmen are required in France to build 200,000 cars. That figures out at five cars per man in this country and two men are required to produce one car in France.

Obituary

Gustav H. Koven, president, L. O. Koven & Brother, Inc., 154 Ogden avenue, Jersey City, N. J., died Monday, June 11.

Richard C. King, aged 30, Pittsburgh manager of the Air Reduction Sales Co. of America, one of the few survivors of the famous "Princess Pats," Canadian volunteers, died recently in Pittsburgh.

William H. Whipp, formerly assistant superintendent of the Gorham Mfg. Co., Providence, R. I., died recently after a long illness. He was a native of Lancashire, Eng., and retired from active connection with the Gorham Co. in 1920.

J. S. Roberts, formerly connected with the United States Cast Iron Pipe & Foundry Co., Burlington, N. J., died at his home in Cleveland, June 18. Mr. Roberts was born Aug. 31, 1863, and had been connected with the pipe industry for 34 years. In the past 14 years he had served as resident manager of the Cleveland shop of the United States company.

James S. McCaffrey, one of the founders of the Smithers & McCaffrey Co., Syracuse, N. Y., died recently, aged 75 years. William B. Smith, his associate in the formation of the company 35 years ago, died on March 24. The company took over the old Phoenix foundry in 1911 and Mr. McCaffrey became vice president having served in that capacity until his retirement 5 years ago.

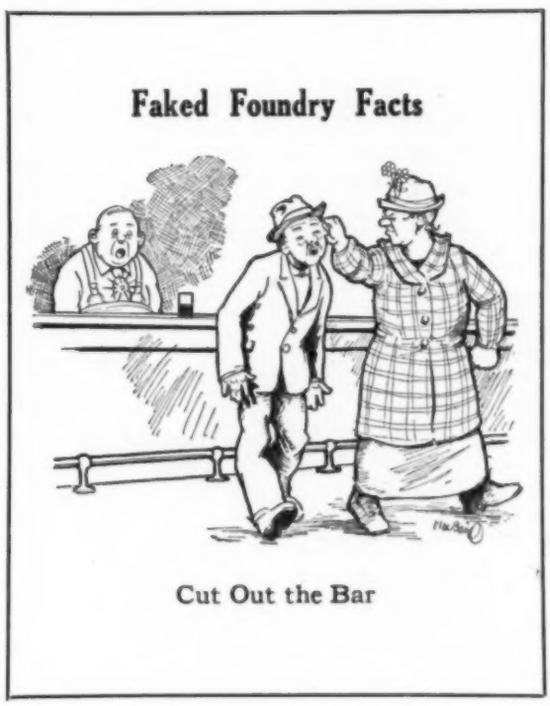
To Handle Supplies

The Denver Foundry Supply Co., 408 Empire building, Denver, Colo., recently has been incorporated by A. C. Hovey, P. M. Payne and A. X. Erickson. The company will carry in stock a full line of supplies of the Obermayer Co., Chicago, and also will represent the Pittsburgh Electric Furnace Corp., Pittsburgh.

Book Review

Standards Yearbook 1928, cloth, 399 pages, 6 x 9¼ inches, published by the United States department of commerce, and may be obtained from the superintendent of documents, United States government printing office, Washington, for $1.

This is the second edition of the Yearbook and contains outlines of the activities and accomplishments of the National bureau of standards and other agencies of the Federal government, states, counties and municipalities. It also includes the work of the technical societies and trade associations during the year of 1927 and their programs for future work. A special feature is made of the accomplishments and current activities of the various foreign, national and several international standardizing agencies. The volume also contains a bibliography on the literature on standardization prepared under the direction of William A. Slade, chief bibliographer, library of congress.



Use Heavier Walls

Higher pressures have comparatively less effect than higher temperatures insofar as approach to the tensile strength or yield point of materials is concerned, according to J. J. Kanter in a paper presented at the A. S. T. M. convention. It has been realized from the first that for high pressures, heavier pipe, valves, fittings, and other pressure vessels should be used. This, therefore, argues against any tendency to make thinner the walls of pipes, valves, fittings and pressure vessels. Such practice may be unsafe not only from the standpoint of giving equipment too light to withstand flow stresses, but also from the standpoint of corrosion, which in some applications of today may be more serious than generally is thought.

Iron Against Steel Blows

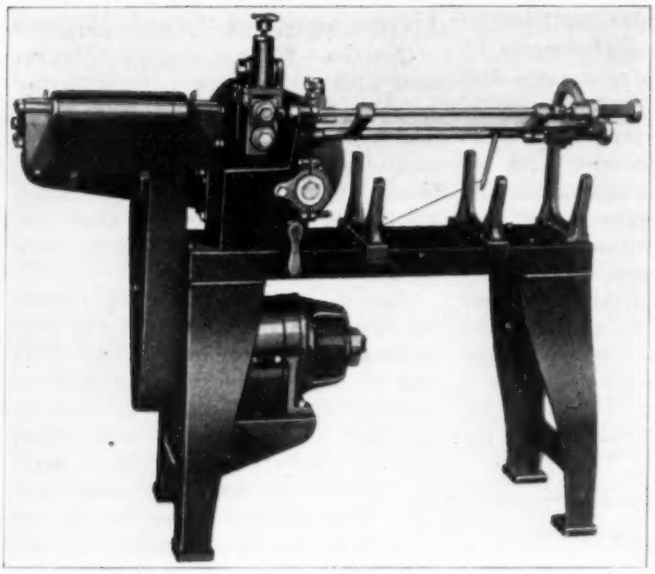
Question—We are making a brakeshoe with a steel back and are having considerable trouble with blow holes. The steel back is dipped into a solution of gasoline and aluminum powder before being placed in the mold. Could you tell us how to avoid the blow holes and get the iron to stick to the steel back?

Answer—It is essential to remove all rust from the surface of the steel against which the iron flows. This can be done by pickling the steel in hydrochloric acid, diluted by pouring one part acid slowly into eight parts of water and stirring well. After the scale and oxide have been entirely eaten off by the acid the part should be removed and placed in hot water to clean off all acid. It should then be dipped into a dilute solution of caustic potash or caustic soda, removed from this and again dipped into hot water. After it is taken out it should be coated with a dilute solution of water glass to which litharge has been added, or it may be dried and coated with shellac. In both cases it must be dried thoroughly at the end. Possibly a better way to clean the steel part would be by sandblasting, after which it could be coated either with water glass or shellac. The object of this treatment is to remove all oxide which might unite with the carbon in the iron to form a gas, and to keep the surface of the steel free from moisture which would form steam when the molten iron strikes it. If the steel plate is used shortly after sandblasting and is kept dry it might be used successfully without any coating.

Receives Degree

Vreeland Tompkins, president, The Smooth-On Mfg. Co., Jersey City, N. J., recently was awarded the honorory degree of Master of Science by Rutgers university, New Brunswick, N. J. The degree was conferred for accomplishments as a chemist and inventor.

The heaviest malleable casting shown in the castings exhibit at the Philadelphia convention of the American Foundrymen's association was a rear axle, banjo-housing supplied by the Meadville Malleable Iron Co., Meadville, Pa. This weighed about 150 pounds and was illustrative of good foundry practice.

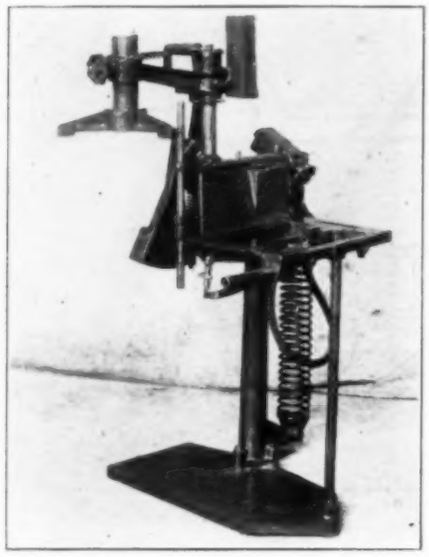


THE AUTOMATIC WIRE STRAIGHTENER IS BUILT IN TWO SIZES

clutch and has a small number of parts. The flywheel shaft revolves only when the wire is being cut off. The cutter bar is operated by a cam on the flywheel shaft. The feed rolls are geared directly to the flywheel. Automatic feed roll release lever, operated directly from the cut off shaft, releases the pressure from the feed rolls when the wire is being cut off. This, it is claimed, prevents slipping of the feed rolls on the wire during the cutoff operation, avoiding marking of the wire and increasing the life of the rolls. The machine is motor driven, the motor being located on a bracket bolted to the leg of the machine.

Introduces Core Machine

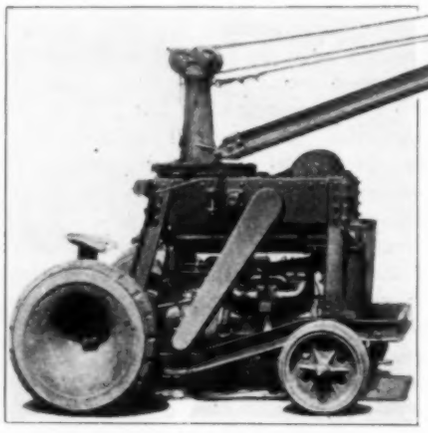
An interesting type of core machine recently has been introduced by the Tabor Mfg. Co., 6225 Tacony street, Philadelphia. The outstanding features claimed for this machine are its simplicity, its lightness and perfect balance and the elimination of unnecessary moves on the part of the operator. A core box is filled and the core plate placed in position in the usual manner. The clamping head then is swung into position over the core box and the draw lever, shown at the back of the machine, is pulled down one-half turn. This clamps and automatically levels in one operation. The machine then is rolled over and the same draw lever reversed is one-half revolution, which unclamps, draws the core and swings it out to a convenient position for the operator to carry away. A view of the core machine is shown in the accompanying illustration at the right.



SIMPLICITY OF OPERATION IS A FEATURE CLAIMED FOR THE MACHINE

Wire Cutter Operates Automatically

An automatic wire straightening and cutting machine recently has been introduced by the Lewis Machine Co., 6303 Central avenue, Cleveland. This machine, which is made in two sizes, designed to handle wire up to 3/16-inch and ¼-inch diameter, has the main drive shaft and flywheel, and the straightener arbor, supported by roller bearings manufactured by the Timken Roller Bearing Co., Canton, O. The straightener arbor consists of five sets of dies made either of hard iron or bronze, depending on the finish of the wire to be straightened. The clutch is similar in construction to the standard punch press



THE HOISTING DRUM IS CONNECTED TO A SELF-LOCKING WORM GEAR

Wants Proper Analysis

Question: What is the proper analysis for stoveplate and furnace work?

Answer: The analysis for stoveplate should be approximately: Silicon 2.25 to 2.50 per cent; manganese 0.50 to 0.60 per cent; sulphur as low as possible; phosphorus 0.50 to 1.00 per cent.

In furnace work lower the phosphorus to about 0.60 per cent. Furnaces have to withstand more strains than ordinarily attained in stoveplate and lower phosphorus will prevent cracking. High phosphorus makes the metal more fluid and is desirable in ornamental work and thin sectioned castings.

If the castings show a coarse open fracture reduce the silicon, as this will close the grain. This should be done gradually.

Mounts Crane on Tractor

Frederic H. Poor, Inc., 50 Church street, New York, recently introduced a small type swing-crane which is mounted on an industrial tractor. The frame upon which the mast is located, consists of a fabricated plate and channel structure, secured at the rear to the axle housing of the tractor. The frame is suspended at the front in such a way as to compensate for irregularities in the floor or road-bed over which the machine travels.

The hoisting drum is connected directly to a self-locking worm gear, and is operated from the power take off through a clutch and bevel pinions by a control lever within easy reach of the driver. When the drum is not in motion the self-locking worm gear holds the load in suspension on the boom without the use of a friction brake. The swinging boom is constructed of two steel channels firmly braced together and equipped with necessary sheaves and hook weight. The wheel by which the boom is swung about the mast, is power driven through a chain and sprocket and is equipped with an expanding brake which permits the boom to be controlled while swinging or set in a fixed position when not under power. A view of the small locomotive type crane is shown in the accompanying illustration.

Cleaning Room Progress Aids Production

(*Concluded from Page* 596)

bags are fastened at the bottom by two metal rods inserted in the bottom hem and clamped down in adjacent channels with half round, wooden strips as shown in Fig. 83. The ends of the mouth of the bag are sealed between two wooden clamp blocks. The bag may be removed easily by removing the thumb screws holding the wooden blocks and strips. The cloth bags are closed at the top and are supported by a rod inserted in the hem and carried on the hook end of a turnbuckle supported by the spring, previously mentioned. The tension on the bag is adjusted through the turnbuckle. A shaking rod passes through the center of each row of turnbuckles. Bags are shaken without disturbing the adjustment and the shaker swings the turnbuckle in an arc, thus shaking the bags horizontally as well as vertically. This motion causes a snapping action to free the cloth from the dust.

While the filter type arrester is designed to retain all of the dust in the air, the cyclone collector is designed to remove practically all of the dust. The exceptionally fine dust will pass through the cyclone type equipment and therefore a pipe must be provided to carry the discharge from the collector to the outside of the building, where it is dissipated in the atmosphere. The cyclone arrester consists essentially of a circular metallic container which has several curved baffle plates designed to change the direction of the dust-laden air. Air entering the chamber is given a rotating or whirling motion, which causes the dust to be thrown toward the outside casing, where it is held and caused to move forward and downward. The free air escapes into the atmosphere.

This is the ninth of a series of articles describing cleaning room equipment. The tenth, dealing with the process of pickling, will appear in an early issue.

Increases Capacity by Changing Design

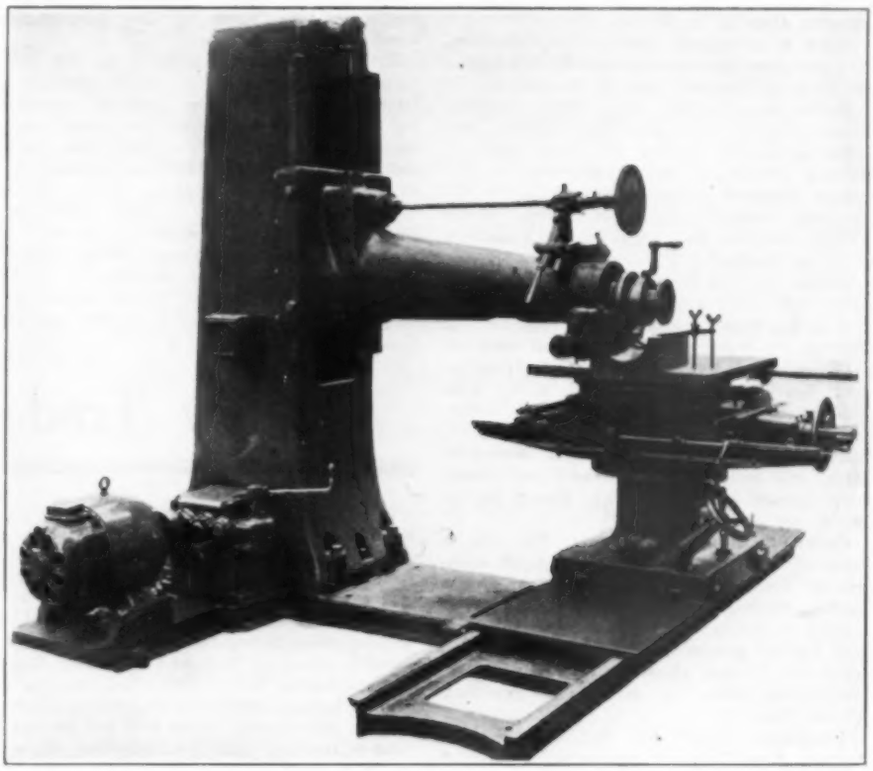
Wadkin & Co., Green Lake Works, Leicester, England, recently has made changes in the design of their semi-automatic patternmaker and universal wood milling machine. This machine, which is shown in the accompanying illustration, has a large capacity. The work table is 32 x 35½ inches, the longitudinal traverse travel of the table is 36 inches and the lateral traverse 24 inches; the bodily movement of the table along the rails is 7 feet 3 inches, the mechanically controlled limit of radius work 48 inches, and the approximate floor space with maximum movements 10 feet 9 inches by 10 feet 9 inches.

The main frame has machined slideways to receive the overhanging arm which carries the spindle head. The arm can be raised or lowered by power or hand feed. The spindle head swivels between the vertical and horizontal in either direction. The principal angles are indexed and located by a spring plunger taper pin engaging with suitable holes, intermediate angles being secured by convenient locking handle.

The spindle is reversed by a hand-wheel on the capstan head. The feed gear for the cutter spindle is controlled by a quick hand feed lever mounted in the center of the capstan head concentrically with the control wheel. It is arranged with a spring plunger to give definite depths of feed, and a micrometer hand feed is fitted to give time readings. The spindle drive is so arranged that the cutter spindle may be dropped below the level of the arm, allowing the spindle to enter a corebox with its axis parallel to the surface of the work. Three speeds are provided.

The work table has two motions at right angles, both of which are operated by screw and handwheel. It also may be floated to and fro by hand. It has a rotary movement for circular and radius work. The table is graduated for convenience in setting the work. The center is recessed so that cutters may be lowered below the surface of the table. The table body frame, upon which the compound slides are mounted, has a secondary rotary motion to enable the work table and slides to be turned to any desired angle.

The Oliver Machinery Co., Grand Rapids, is the agent for this machine in the United States.



THE MAIN FRAME HAS MACHINED SIDE-WAYS FOR THE OVERHANGING ARM THAT CARRIES THE SPINDLE

Metal Needed for Chills

Question: Can you advise us what kind of a paint or preparation can be put on a sand core that will give the same effect as an iron chill?

Answer: There is no commercial means of chilling cast iron except by the use of metal chillers. It is necessary to have a body against a casting, which will absorb a large amount of heat quickly, and the sand would not do this from anything but a thin section no matter how its surface was prepared.

Stanley H. Chadwick, for many years associated with the Watson Engineering Co., New York, has now established his own business at 140 Cedar street, that city. Mr. Chadwick is a consultant on foundry and machine shop practice, layouts, etc.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Refinery Casting Corp., Dallas, Tex., will build a plant.

Aurora Foundry Co., 385 Spruce street, Aurora, Ill., has let contract for a 1-story addition 45 x 140 feet.

Chevrolet Motor Co. is having plans prepared by Albert Kahn, Detroit, for four factory buildings to be erected at Saginaw, Mich.

Waterbury Farrel Foundry & Machine Co., 453 Bank street, Waterbury, Conn., soon will award the contract for a 2-story plant.

Anderson Pattern Works, 924 West Twelfth street, Erie, Pa., is rebuilding its burned plant. (Noted July 1.)

Iowa Foundry Co., Cook and West Second streets, Sioux City, Iowa, will build a 1-story machine shop 50 x 63 feet.

Brass & Aluminum Products Co., Newport, Ky., has been incorporated with $10,000 capital by Theodore Reynolds and O. Burbank.

Armstrong Foundry Co., 1530 Junction avenue, Racine, Wis., gray iron castings, will build a 1-story addition 75 x 80 feet. J. Mandor Matson, Racine, is architect.

Fire damaged part of the plant of the Dempsey Foundry Co., 249 North Water avenue, Sharon, Pa., recently. The damage is being repaired.

Adams Co., 111 West Sixth street, Dubuque, Iowa, will build a 1-story addition 80 x 220 feet to the foundry and machine ship. W. L. Yokom, 730 Main street, has general contract.

Golden's Foundry & Machine Co., Columbus, Ga., has increased its capital stock from $100,000 to $500,000. No expansion is anticipated.

Standard Automotive Parts Co., Muskegon, Mich., will build a 1-story foundry and laboratory. Frank P. Allen & Son, Grand Rapids, Mich., are architects.

Crown Smelting Co., Chester, Pa., has a contract from the government for 20 manganese bronze propellers for scout cruiser service, totaling about $75,000.

East St. Louis Casting Co., Sixteenth street and Kansas avenue, East St. Louis, Ill., will build its furnace plant at St. Clair avenue and Alton street. R. M. Hill is president. (Noted June 1.)

Fitzgibbons Boiler Co., Inc., 570 Seventh avenue, New York, is rebuilding a foundry 70 x 200 feet, replacing an older building. The company expects to be in the building soon.

Washington Brass Foundry, Washington, N. J., formerly owned by Cochran brothers, is being enlarged by an addition to the building and installation of five pit brass furnaces.

Capitalization of the Pelton Steel Casting Co., Chicago road and Elliott place, Milwaukee, has been increased from $50,000 to $200,000. The concern is planning to enlarge its capacity, but no details have been divulged. A. J. Ehne is president.

National Foundry & Machine Co. Inc., Worcester, Mass., has been incorporated with 100 shares no par value stock to manufacture wire drawing tools and machinery, general tool making and machine work, by John G. Enberg, 56 Forsberg street.

Duplicate Parts Co. Inc., Boston, has been incorporated with $25,000 capital to manufacture castings and machinery, by Herbert F. Robert, president and treasurer, 93 Gilbert street, Malden, Mass.; Frank B. Sparks, 13 Oxford street, Malden, clerk; E. A. Roberts.

Bethlehem Shipbuilding Corp. Ltd., Bethlehem, Pa., has let contract to the Austin Co., 1015 Chestnut street, Philadelphia, for machine and fabricating shop, woodworking shop, pattern shop and control house at the ship repair plant on Key highway, Baltimore.

Locke Pattern Works Inc., Detroit, and Ypsilanti Motor Casting Co., Ypsilanti, Mich., have been bought by the American Radiator Co. Both companies have been engaged in producing castings for the radiator company for some time.

Aetna Foundry Co., Twentieth street above Hunting Park avenue, Philadelphia, has been consolidated with the Pennsylvania Bronze & Brass Co. Inc., Twenty-second and Master streets, Philadelphia. This company will operate under the name of the Pennsylvania Bronze & Brass Co. Inc.

U. S. Hoffman Machinery Corp., 329 Temple street, Syracuse, N. Y., has let contract to Dawson Bros., 231 Union building, Syracuse, for a group of 1 and 2-story factory buildings. Lockwood-Green Co., 100 East Forty-second street, New York, is architect and engineer. (Noted May 15.)

A $1,350,000 merger of four rubber machine manufacturing companies, recently announced, involves the Akron Rubber Mold & Machine Co., the Kuhlke Machine Co. of Akron, the Banner Machine Co. of Columbiana, O., and De Mattia Bros. Inc. foundry and machine company of New Jersey. Stanley Harris, president of the Akron Mold & Machine Co., has been named temporary president of the new organization, while M. D. Kuhlke is treasurer. Barthold De Mattia will be vice president. The new company will serve about 80 per cent of the rubber manufacturers in America.

Ohio Foundry Co., 9608 Quincy avenue, Cleveland, has awarded the general contract for a 1-story foundry, 101 x 200 feet, to H. G. Slatmeyer & Son. It is expected that the building will be completed in the fall. W. H. Smith is president of the company. (Noted July 1.)

J. P. Devine Co., 1372 Clinton street, Buffalo, has been reorganized as the J. P. Devine Mfg. Co. and a substantial interest has been taken over by the Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill. The new company will continue the manufacture of dryers, evaporators, impregnators, chemical and sugar appliances. Additions are being provided to accommodate larger production. Walter C. Arthurs, president of the Mt. Vernon Car Mfg. Co., is chairman of the board, Joseph P. Devine is president; H. H. Cust, vice president; Charles P. Devine, vice president; C. W. Reynolds, secretary; D. P. Settlemire, treasurer, and Graham Devine, assistant to the president and plant manager.

New Trade Publications

FLEXIBLE SHAFTS—N. A. Strand & Co., 5001 North Lincoln street, Chicago, manufacturers of flexible shafts and equipments, recently has issued a new catalog of 48 pages covering several new types of machines and attachments.

CHAPLETS—Milwaukee Chaplet Co., 539 Thirty-first street, Milwaukee, recently has issued a small handbook on chaplets and foundry riddles. The publication is well illustrated, showing the various types of chaplets with detailed information on dimensions. Prices also are given.

ELECTRICAL EQUIPMENT—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a new catalog of electrical supplies for 1928-1930. This catalog presents the electrical and mechanical features and application information for all supply apparatus and appliances manufactured by the Westinghouse company, and in addition describes and illustrates a representative list of large motors and generating apparatus. The new catalog with approximately 1200 pages contains a treasure of information for the practicing engineer.

AIR COMPRESSORS—A bulletin on compressors and vacuum pumps has been prepared by Ingersoll-Rand Co., New York. It covers small and medium size machines. They are for use with air or gas, straight-line type, single-stage, two-stage or three-stage. The bulletin shows details of construction and furnishes engineering data.

STARTING EQUIPMENT—The Allen-Brady Co., 286 Garfield avenue, Milwaukee, recently have issued a series of bulletins and price sheets which may be incorporated in the loose-leaf catalog of that company. The bulletins cover various types of starting switches, automatic starters, a reversing switch, and a push button master station.

CONVEYING MACHINERY—Link-Belt Co., Chicago, has issued a new catalog covering all its products. A large quantity of engineering data, list prices and illustrations of parts and installations are included. The book contains 1088 pages and covers completely the chain, sprocket, power transmission, elevating and conveying and engineering divisions of the company's business.

INDUSTRIAL HANDLING—Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has issued a bulletin to show that proper handling of materials will produce more castings per dollar. The bulletin includes a series of illustrations showing installations for economical handling of materials and products in foundries.

AIR COMPRESSORS—Sullivan Machinery Co., Chicago, has issued a bulletin on its angle-compound power driven air compressors, with capacities of 300 to 5100 cubic feet of air per minute. The bulletin contains a number of illustrations showing installations operated by direct connected diesel engines, by short-center belt drive from electric motor, by direct connected motor drive in single and twin units and others equipped with start and stop control.

NICKEL CAST IRON—A bulletin presenting data on wear and machinability of cast iron alloyed with nickel has been issued by the International Nickel Co., New York. Microphotographs of various sections of cast iron illustrate the text.

AIR COMPRESSOR—Pennsylvania Pump & Compressor Co., Easton, Pa., has issued a bulletin on a multiple, belt-driven, semiportable air-compressor unit, arranged for automatic start and stop control. It supplies 65 cubic feet of free air per minute. The feature of this unit is its compactness and the fact it is self-contained.